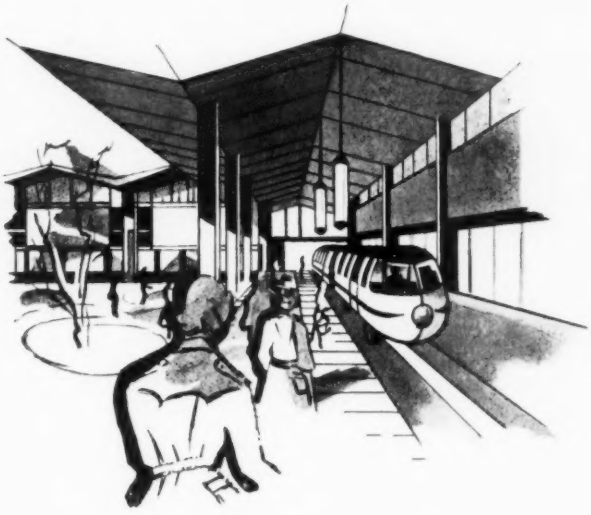
26 MAY 1961

METAL INDUSTRY

THE JOURNAL OF NON-FERROUS METALS



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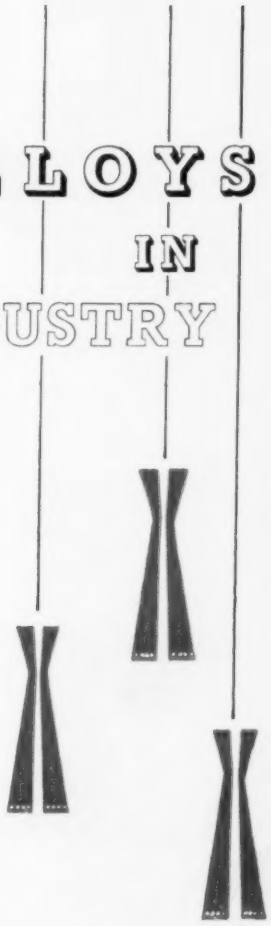

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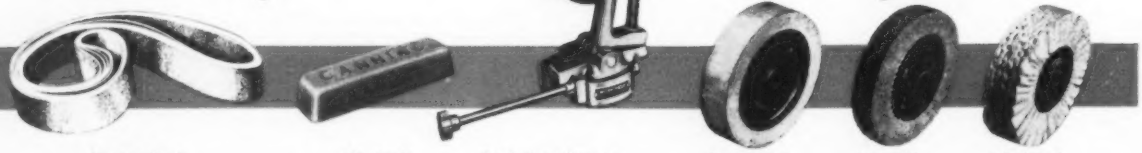

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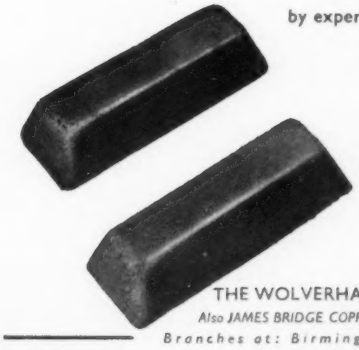

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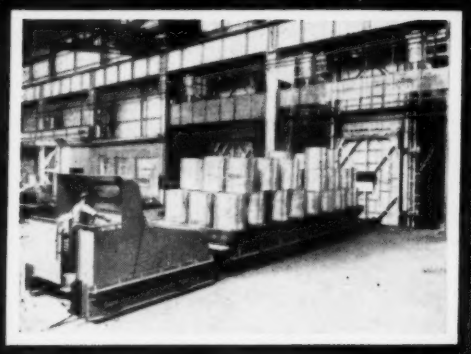

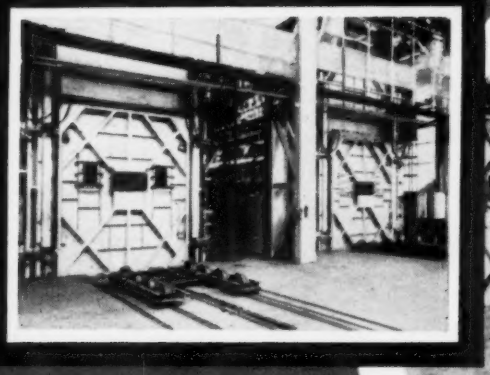

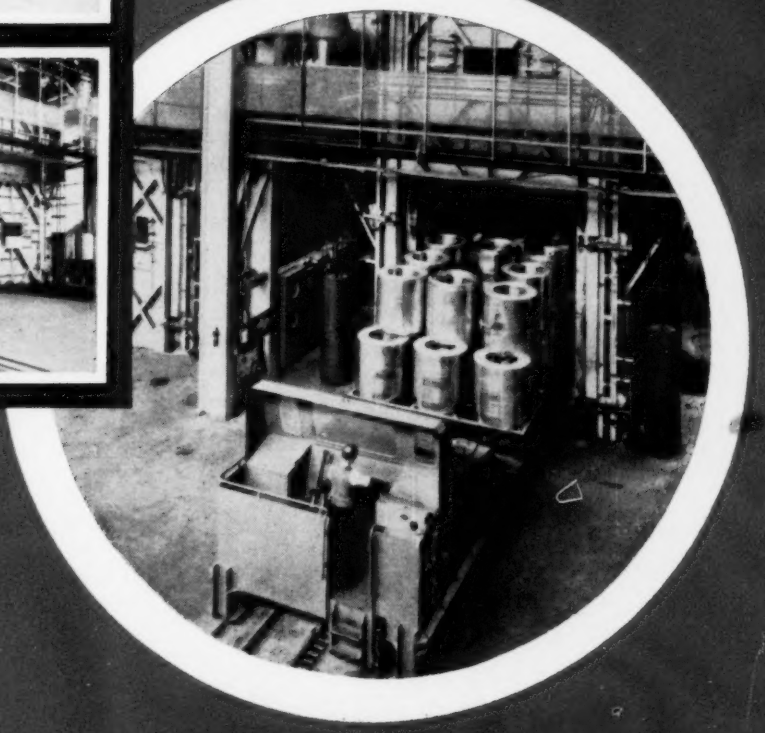

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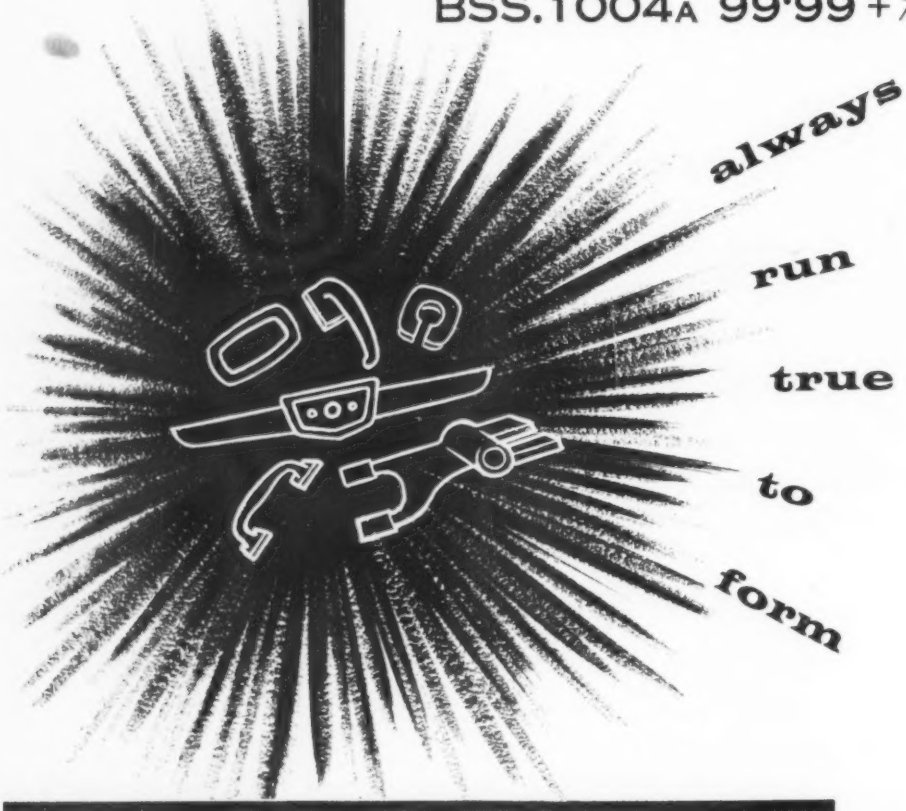

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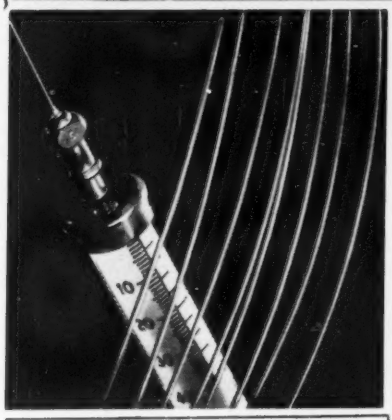

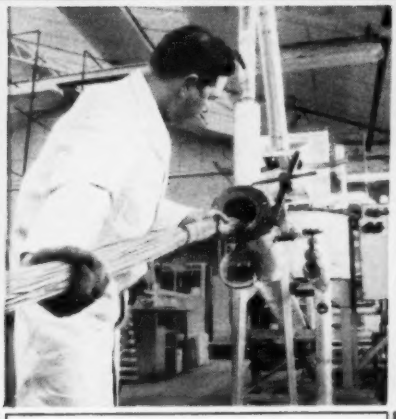

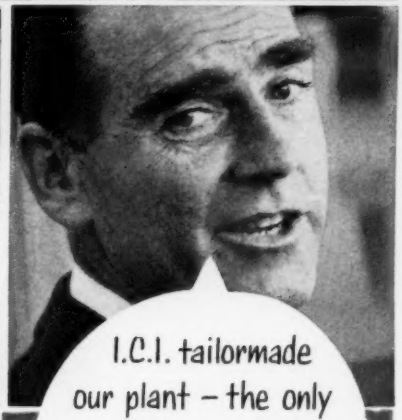

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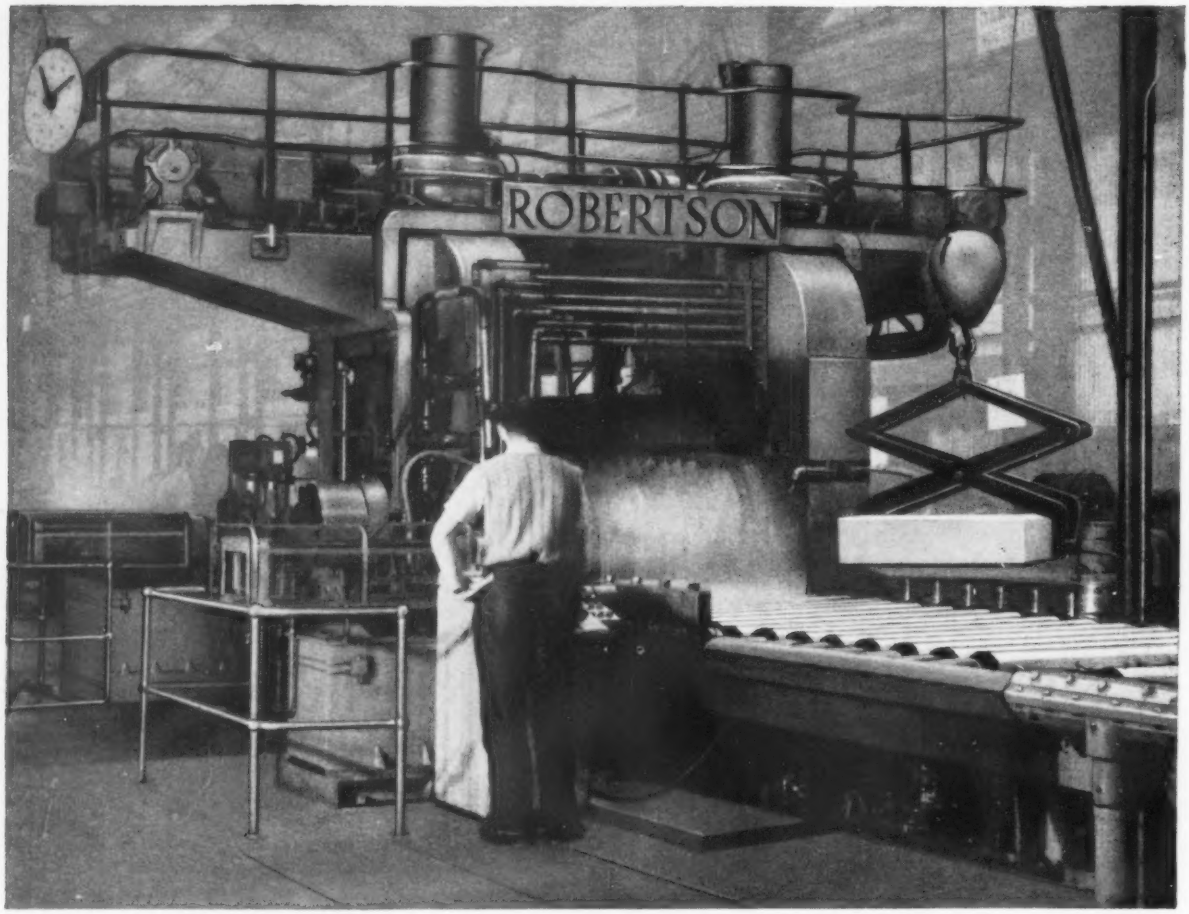

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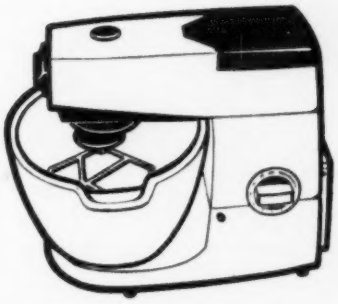

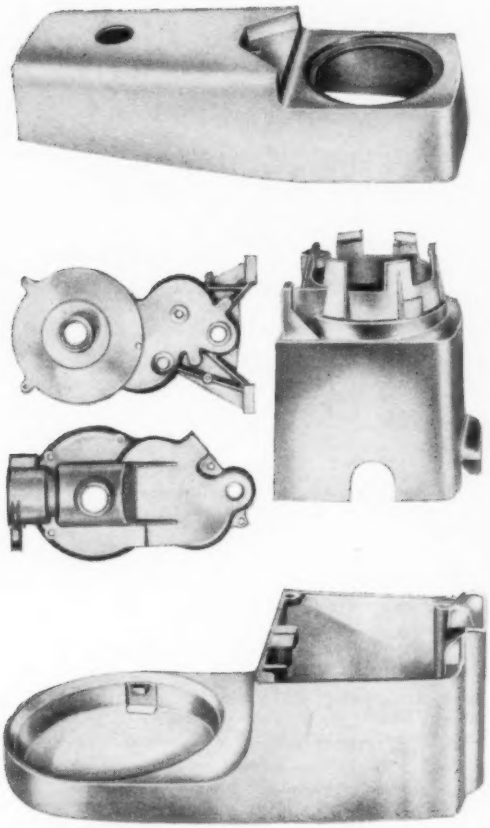

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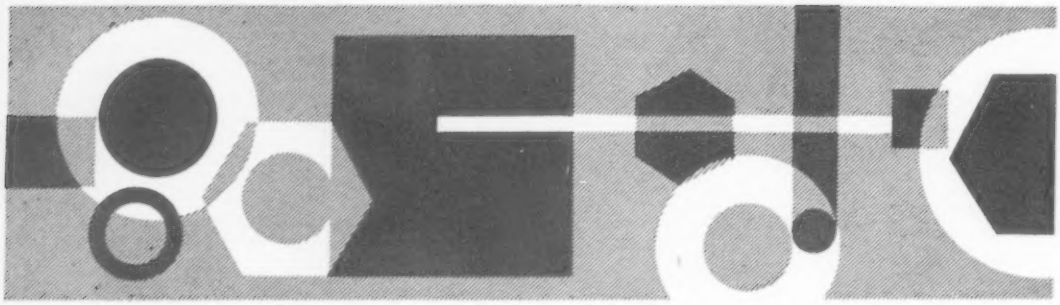

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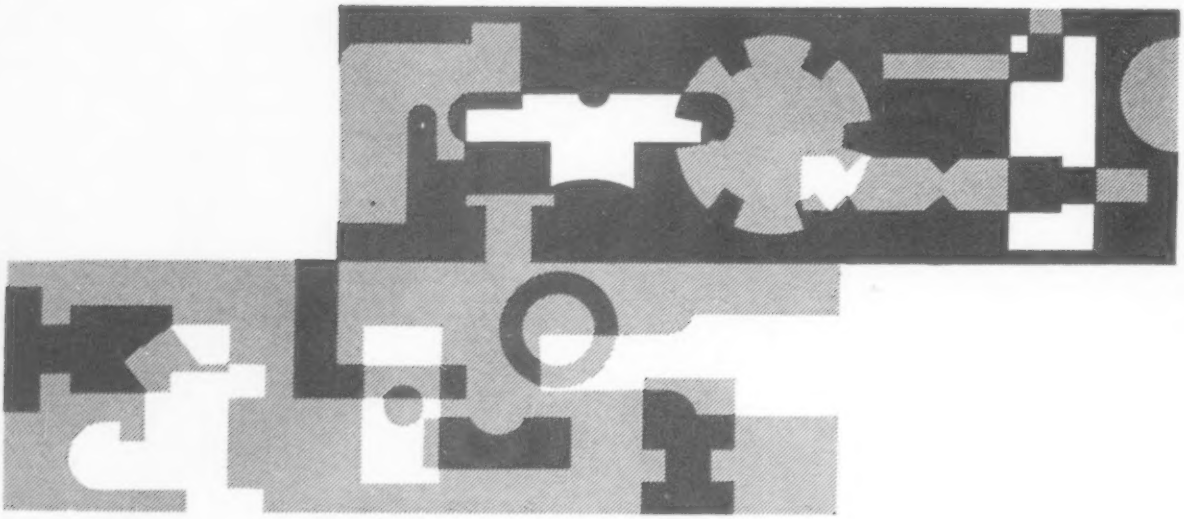

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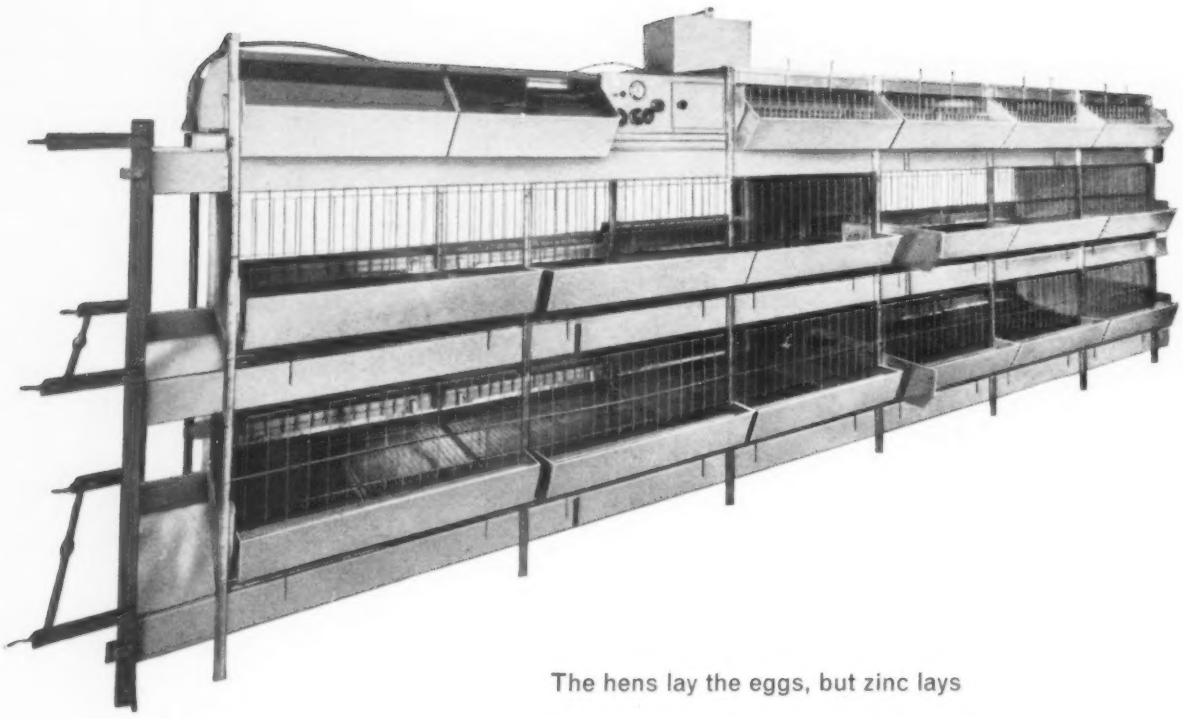

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BISRA Report

METALLURGISTS have long deplored the artificial separation of the various branches of their profession brought about by the current call for specialization. Thus it is doubtful whether those whose main interests lie in the non-ferrous metals industry are fully aware of the work done by the British Iron and Steel Research Association. Yet a study of the latter's Annual Report reveals many items that warrant their attention.

For instance, research into the mechanism of lubrication during cold rolling has demonstrated the possibility of reducing friction and wear by grinding the rolls transversely instead of circumferentially as is done at present. Pilot experiments on a production mill have shown that although the experimental finish disappeared after only a few coils had been rolled, the roll wear between dressings was greatly reduced and the final appearance of the worn roll was conspicuously better. Steps are being taken to devise practical methods of obtaining this finish in industrial roll dressing shops.

Considerable interest has been shown in industries other than the steel industry in a novel technique of non-contact strip-speed measurement. The basis of the method is that the strip surface is illuminated with two spots of light arranged approximately 15 in. apart and in line with the direction of motion of the strip. Two photocells are arranged to view separately the light reflected from the surface at these spots. As the strip passes, variations in its surface cause variations in the reflected light intensity and, since the same portion of surface passes the two filament images in turn, the light signals received by the two photocells are the same, apart from a delay in time. The earlier signal is delayed on a tape recorder, the two signals are then correlated and the delay is adjusted until the correlation is a maximum. The strip speed is then known from the delay and the distance between the images. Application of speed meters based on this principle is envisaged for measurement of strip speed in a tandem hot-strip mill, thereby monitoring continuously the thickness reductions through the mill.

With the object of reaching a better understanding of the deformation processes preceding the initiation of microcracks, so that guidance may be obtained on methods of improving the fatigue behaviour of metals, research has been carried out on oxygen-free high conductivity copper since this metal has attained the status of a reference material in fatigue research. Extrusions have been observed on the free surface of fatigued specimens, and these have been found to be associated with intrusions when taper-sections were prepared. The taper-section also revealed the nature of the persistent slip bands, produced by electropolishing, to be that of an electrogroove penetrating into the bulk of the material and resulting in a decrease in both static and subsequent fatigue strength. The electrogroove is formed on electropolishing because of the localized damage to the metal structure in the slip band.

Still partly in the field of non-ferrous metallurgy, good progress has been made on the development of a process for coating steel strip with aluminium by electrophoretic deposition of aluminium powder, followed by rolling and heat-treatment. The coating obtained is more uniform than that obtained by hot dipping and thickness can be controlled to fine limits over a wide range. There is very little alloy present, porosity is so low that the surface can be anodized and the steel can be severely deformed without any deterioration of the coating.

Out of the MELTING POT

More Than A Lubricant

THIN film lubrication in the extrusion of metals is better than no lubrication at all, but is certainly not the final answer. A better answer is the use of glass and similar materials to form thicker and more viscous lubricating layers in the hot extrusion of metals and alloys of low plasticity. It has given good results, but the practice is not free from difficulties occasioned by the non-uniform distribution of the lubricant under pressure, and the risk of solidification and loss of lubricating properties in the case of the higher melting point glasses. Better and more consistent results can be obtained by enclosing extrusion billets in a sheath of a more ductile metal with, for good measure, an insert of the same metal between the front end of the billet and the extrusion die. Apart from assisting the flow of the metal being extruded, such a sheath of ductile metal has, of course, also been used to protect extrusion billets of reactive metals against the atmosphere during preheating and extrusion. In spite of the vast difference between a film of some conventional lubricant and a sheath of ductile metal on an extrusion billet, one is left with the impression, on studying accounts of investigations into the extrusion of such metal-sheathed billets, that the ideas behind them, and consequently the scope of such investigations, are not entirely free from the concepts of conventional lubricants and lubrication. One result of this influence is that a great deal more attention has been given to the provision of a sheath, to the actual metal used, and to the effect of both on the flow of the billet during extrusion, than to the effect of the thickness of the sheath. The general feeling seems to have been that, since the sheath is so much thicker than a film of lubricant, it should be more than adequate for its function as a lubricant. Only quite a recent investigation, in which the effect of varying the sheath thickness was studied, has revealed that when the latter reached a certain critical thickness, there occurs a fundamental change in the flow pattern of the core billet, with complete elimination of shear (which becomes confined entirely to the sheath), the core billet being deformed purely by extension. This, on the one hand, makes possible the extrusion of metals and alloys of very low ductility and, on the other, the reduction or suppression of the familiar non-uniform distribution of the degree of deformation over the cross-section of an extruded section.

More Lessons

IN spite of the enormous amount of interest being taken in the achievements of the Soviet and American programmes of space rockets and ships, and despite all the discussions of various aspects of these programmes, by no means all the possible conclusions have as yet been drawn, nor certainly all the possible lessons learnt. In the case of two such conclusions that come to mind, a probable reason for their neglect is that they are far less controversial than many other aspects of this work. One of these two conclusions is that on the evidence provided by the progress of the two space programmes, duplication of research need not always be as unfortunate and undesirable as it is invariably made out to be. Indeed, it could be argued that concerted advance action intended to eliminate duplication in this, or for that matter in any other programme of research, must also result in the elimination, at the same time, of a measure of profitable diversity. The old saying that two heads are better than one must be modified by the proviso that they should be in different (duplicate) research programmes. The second not unrelated conclusion is that the benefits to be expected from a duplication of research should be fostered by a far-reaching suppression of the publication of details of the investigations concerned. Whatever the reasons, suppression of communication and publication of details has certainly been achieved so far as the development of space rockets is concerned. The work itself, the potential readers with their chronic lack of time, and technical librarians with their chronic lack of shelf space, have all benefited thereby. And now, having drawn the above conclusions, would it not be opportune to consider wider applications of the lessons learnt therefrom?

No Evidence

A GERMANICALLY long-winded title of a recent two-part article draws attention to the relevance of theories of sintering to the production of thermoelectric materials by powder metallurgy. In view of this undoubted relevance, it need not perhaps be surprising that the whole of the first part is devoted to a thorough survey of the numerous, diverse, inconsistent and, in part, contradictory theories that have been put forward. The confusion is admirably illustrated by a diagram in which the phenomena involved in sintering, from adhesion through lattice diffusion to vacancy diffusion, postulated by nine different theories, are "plotted" against the sintering temperature : melting temperature ratio. It is probably a combination of politeness and confusion that finally leads the authors of this survey to the conclusion that sintering must probably be described in terms of a number of overlapping mechanisms and of a combination of theories rather than of any one theory; the exact combination depending on all the circumstances of any given case, and elucidation of which cannot be achieved by short cuts such as, for example, the measurement of activation energies. An undesirable phenomenon occasionally observed in sintering is the dimensional growth and consequent reduction in density that may develop under certain conditions. It need not, therefore, cause much surprise that the second half of the second part of the article is devoted to a survey of the theories and mechanisms suggested by way of explanation of this phenomenon, nor that, in view of their diversity, no attempt is made to arrive at any conclusion. What is surprising and rather disappointing is that the results of the experimental work carried out in the laboratories of the Siemens-Schuckertwerke A.G., Nürnberg, and reported in the middle of the second part of the article, include no data on thermoelectric properties, though admittedly the material investigated—bismuth telluride (Bi_2Te_3)—is certainly a useful thermoelectric material. It was prepared by cold pressing and sintering the powders of the two elements mixed in the required proportions, and results are reported illustrating the relations between density, compacting pressure and sintering temperature, and also showing the possibility of subsequent coining of the brittle material provided flow in a direction transverse to that of the coining pressure is prevented.

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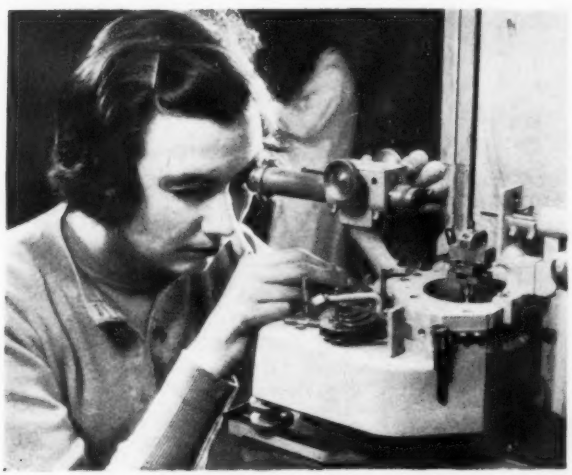
The McFadzean Laboratory

CENTRAL RESEARCH FACILITIES FOR THE BICC GROUP

ADDITIONAL scientific and technical facilities have now been made available to the Research Organization of British Insulated Callender's Cables Ltd., by the opening of the McFadzean Laboratory at Wood Lane. The Research Organization, which is concentrated in the Wood Lane laboratories, is responsible for carrying out such long-range experimental work as is necessary to feed to the Group's engineering laboratories the information which they need to fulfil their shorter-range objectives, and to conduct basic research in fields of lasting interest, regardless of immediate applicability. It also provides central facilities where they are required by several factories but which demand such specialized personnel or equipment that a number of separate laboratories would be uneconomic or inefficient.

The McFadzean Laboratory is a six-storey building providing 64,000 ft^2 of floor space. It accommodates the instrumentation and control department, the physics department, British Dielectric Research Limited (a Group subsidiary for research on capacitors), the diffraction and microscopy department and, in addition, the electronic computer, which is an important part of the facilities of the mathematics department, the main offices of which are elsewhere. Also, the laboratory contains the drawing office, the photographic section, the main conference room, a lecture room, some administration offices and catering and social facilities.

The laboratory has a complete basement which, besides having accommodation for the storage of records, the electrical sub-station, refrigeration and space-heating plant and the automatic telephone equipment, provides a large space to be used for life-testing and similar long-term tests which need only occasional supervision.



Aligning a specimen for the X-ray diffraction camera in the Diffraction and Microscopy Department

The ground floor contains the entrance vestibule and the conference room, but is otherwise wholly occupied by the instrumentation and control department. This department is one of those which provides a centralized service to the Group and is responsible for:

(a) developing novel measuring devices, mainly for use in the factories in non-destructive quality control testing;

(b) designing and constructing complete schemes of instrumentation, using either specially developed or conventional equipment; and

(c) devising automatic production equipment to replace and improve upon existing manual control methods, to improve product quality or to economize in material usage.

Work in progress includes:

A.C. spark testing of rubber and plastics cable insulation, using a D.C. spark of very low energy.

Monitoring uniformity of spiral pitch in spiral elements such as are used, for example, in electric blankets.

Electromagnetic testing employed in the quality control of the manufacture of wires and metallic tubes.

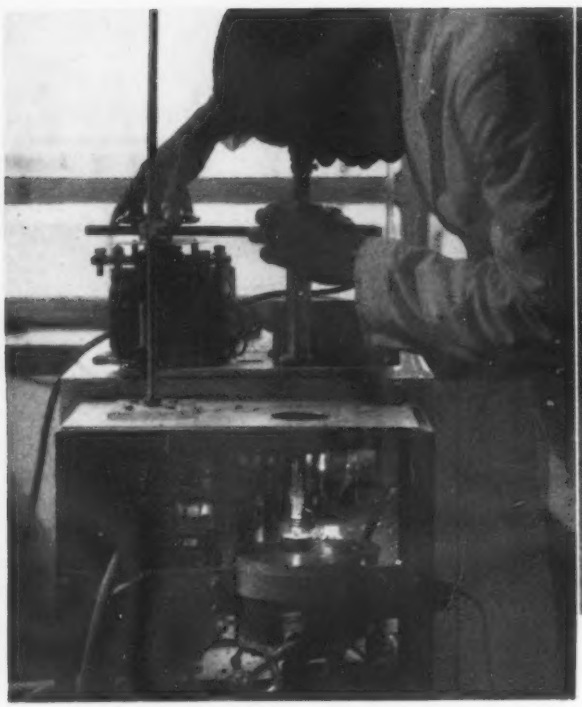
Instrumentation for surveying the behaviour of overhead electrification equipment for railway electrification.

Flash vulcanizing.

Devices for the transport of wire through various cablemaking processes and to control quality.

Accurate control of thickness and concentricity of the submarine lead pipe.

The physics department occupies the whole of the first floor and nearly all its work is of a long-range nature and



Left—Sintering of porous tantalum anodes in the Capacitor Department (British Dielectric Research Ltd.)

Above—Measuring head of the continuous lead sheath gauge developed by the Instrument and Control Department

largely concerned with the dielectrics used for power cables of all descriptions. Of necessity, the department has its own high voltage testing equipment, which is normally of adequate range, but if higher voltages or currents are needed the larger facilities of the main high voltage department are available.

The second floor is devoted to research on capacitor dielectrics, in the hands of British Dielectric Research Limited, which serves both the Capacitor Division of BICC and the Telegraph Condenser Company Limited, a BICC subsidiary. The department has sections dealing with all types of capacitors—oil-impregnated paper, electrolytic, metallized plastics, ceramic, etc.—and possesses equipment for manufacturing laboratory specimens of all kinds. It also has an extensive range of measuring facilities for the study of initial characteristics and life performance. A few examples of the work of B.D.R. are the following:

If gaseous cavities are present in a capacitor, the ionic discharges which may occur under electric stress can impair the efficiency of the capacitor and shorten its working life. The measurement of ionization in a paper capacitor, and the influence of pressure upon it, are therefore important.

Unusual duty cycle imposed upon capacitor elements when they are used in energy storage capacitors in thermonuclear research.

Self-healing characteristics of vacuum-metallized plastics film permit the use of very thin dielectrics and, hence, permit the size of capacitors to be reduced.

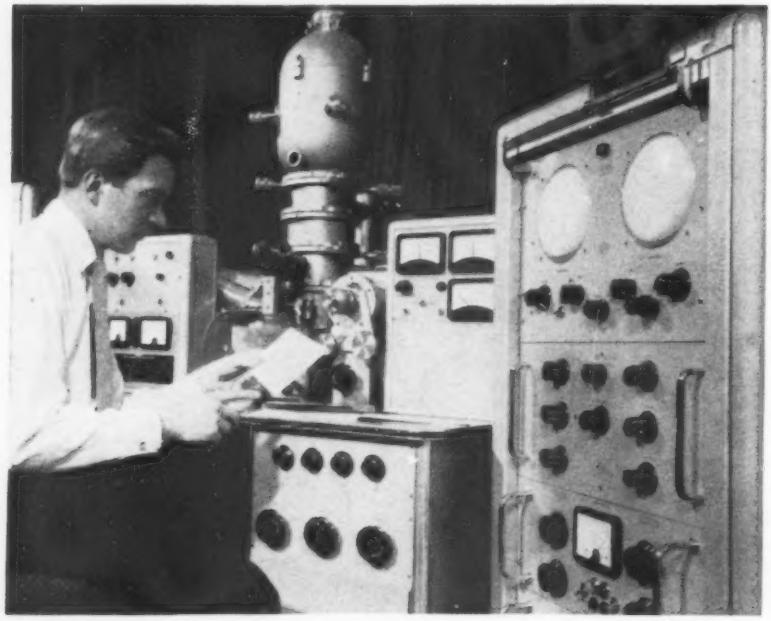
Electrolytically-formed oxide film on certain metals may be employed as a capacitor dielectric. Current work includes the method for forming the oxide on tantalum foil.

The third floor houses the drawing office, the diffraction and microscopy department and the photographic section.

The diffraction and microscopy department is concerned mainly with the fine structure of materials and provides an analytical service of this nature to all other departments of the Organization. It has its own research programmes, but these are mainly concerned with improvements in its own techniques. There are three main items of equipment.

The X-ray micro-analyser is an

The X-ray scanning micro-analyser in the Diffraction and Microscopy Department



instrument of recent development. The specimen which is being examined is scanned by an electron beam only 0·001 mm. in diameter. The X-rays which are generated, the wavelengths of which are characteristic of the elements in the surface of the specimen, are analysed and the results displayed either visually on the screen of an oscillograph as an "X-ray image", or automatically recorded. This enables elements which are present only in minute quantity to be located and identified. The technique is especially valuable in metallurgical studies for the examination of segregates, alloying constituents, etc.

The X-ray diffraction camera is used in the identification of crystalline elements or compounds and for the determination of crystal orientation and texture.

Lastly, the electron microscope has such resolution that it permits much higher magnifications than are possible with the optical microscope and it has, in addition, such depth of focus that stereo-techniques are readily applicable so that photographs may be produced in three-dimensional form.

The photographic section has many duties of a routine nature, but it is also an essential part of the scientific facilities of the laboratories. Its extensive equipment includes high-speed cinematography, and photographic methods are frequently used for measurement purposes.

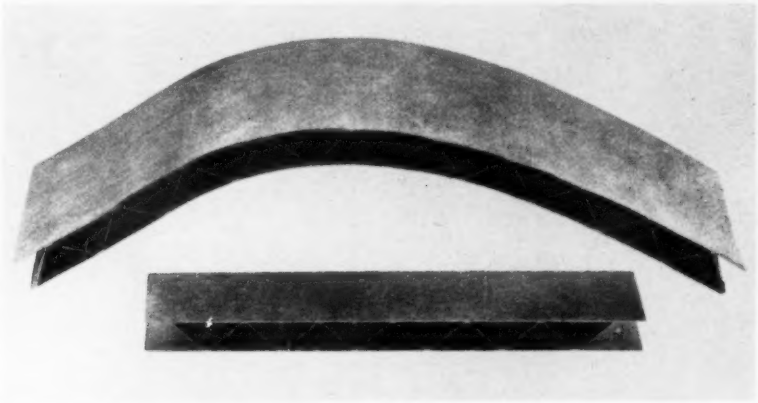
The only laboratory on the fourth floor is that containing the electronic computer, which is used for mathematical and engineering design problems. The computer is particularly useful for the latter, because it has a much larger store than is usually needed for strictly mathematical purposes. One application which is readily understood and demonstrated is the calculation of the control requirements for installing heavy submarine power cables in deep water. The computer was first used for this purpose in 1956, when the Group installed 93½ miles of 138,000 V gas-filled cables linking Vancouver Island with the mainland of British Columbia, and an example which is now topical is the calculation of the control charts which will be used in the laying of the British section of the Cross-Channel D.C. power cables for the England-France interconnection.

The fifth floor is devoted mainly to staff amenities, whilst the partial sixth floor is used only for plant rooms for the ventilation and mechanical services.

Corrugated-Core Sandwich Construction

A METHOD of producing corrugated-core sandwich panels that reduces costs substantially, has been developed in research sponsored by the Douglas Aircraft Company at Battelle Memorial Institute. The method requires no jigging, provides completely sound core-to-cover bonds, and allows the panels to be extensively formed after assembly.

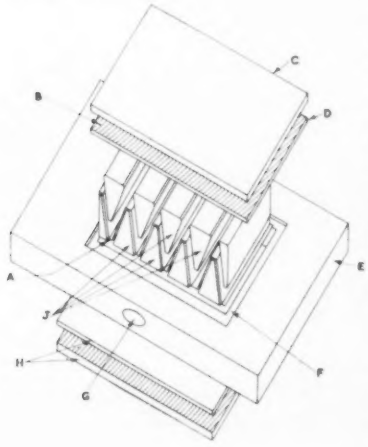
The process—called roll welding—uses hot rolling to pressure-weld the peaks of the corrugated metal core to the cover sheets.



Finished panel produced by leaching out the inserts with acid. Corrugated-core sandwich panels approach the all-round rigidity of honeycomb sandwiches and are simpler and much less expensive to manufacture

Elements of the sandwich pack are held in place during the hot-rolling operation by steel cover sheets welded to a rectangular steel frame. After rolling, the frame is sheared off and the protective covers peeled away

A—Formed titanium corrugation. B—Surfaces painted to prevent bonding. C—Steel cover. D—Titanium cover. E—Steel yoke. F—Recess to receive covers. G—Hole for evacuation tube. H—Bottom covers. J—Copper filler wedges.



Size of the sandwich panels is limited only by rolling-mill capacity. Panels as large as 36 in × 72 in × ¼ in. have already been produced. Roll-welded sandwich panels have been made of 2014 aluminium alloy, B-120 VCA titanium, unalloyed A-55 titanium, steel, molybdenum, and Inconel.

To form the corrugated core, an accordion-pleated sheet of metal is woven over and under V-shaped inserts of a chemically soluble, deformation-resistant metal, such as copper or iron. A rectangular metal frame is placed around the core, and the face sheets of the sandwich are added. The entire assembly is clamped in place by two additional metal cover sheets, which are welded to the rectangular frame. The whole package is then hot rolled in a direction parallel to the corrugations.

In addition to welding the core to both covers, rolling also reduces the thickness of the panel up to 60 per cent to provide desired corrugation shapes.

After rolling, the retaining frame is sawn or sheared off, and the metal covers which were welded to the frame are peeled away. With the support wedges still in place, the sandwich panel can now be formed into a wide variety of shapes, including hemispheres, without buckling the core. Standard tooling can be used, and the panel can be worked as though it were a solid metal plate of equal thickness.

The V-shaped inserts are then leached out of the formed structure with a chemical reagent, such as nitric acid. Although the leaching process requires several days for very large panels, it is a straightforward operation and is relatively inexpensive. If necessary, leaching can be accelerated by mechanical means.

Roll-welding can also be used to produce sandwiches with vertically ribbed cores, since core design is determined by the design of the filler wedges. The only limitation is that the core has to be unidirectional.

Roll-welded corrugated sandwich panels approach the all-round rigidity of honeycomb sandwiches, and are simpler and much less costly to manufacture.

EXTRACTS FROM DISCUSSION ON CORROSION OF NICKEL+CHROMIUM COATINGS

I.M.F. Annual Conference

AT the annual conference of the Institute of Metal Finishing at Llandudno, the first session was devoted to the presentation and discussion of three Papers. The third of these is abstracted on this page, and extracts from the discussion which followed its presentation appear on this and subsequent pages.

DISCUSSION

D. R. Newman (Electro-Chemical Engineering Co. Ltd.) said the particular value of the anode polarization phenomena described was the measure of confidence that it gave in the accelerated corrosion tests discussed—the salt spray and the Corrodkote. Had sufficient samples from cars been examined to ensure that the mechanism of corrosion found for dual layer nickel was applicable in the majority of cases or, in practice, were some completely hemispherical types encountered?

The Paper helped, too, the critical discussion of the sulphur dioxide test—the Kesternek test used widely in Germany, and the B.N.F.M.R.A. test in this country. The Paper showed that it was not a particularly good test owing to chemical attack on metal. This meant that such tests were really porosity tests for chromium deposit. Also, in the case of, say, a dual layer for finely cracked chromium, which seemed to give exceptionally good results in the Corrodkote and acetic acid/salt spray tests, and certainly in outdoor exposure of nickel-plated steel and copper-plated die-castings, sulphur dioxide-containing tests detected the porosity of the finely cracked chromium layer and indicated that a very poor result would be obtained. This was, to some extent, a condemnation of the present sulphur dioxide tests, but he did not think that it should be a condemnation of sulphur dioxide as such. The latter undoubtedly did occur in industrial and city atmospheres and he would like the authors' views on the possibility of including either sulphur dioxide or sulphates in something like the Corrodkote or accelerated salt spray test.

Did the authors consider it was the absence of sulphur in semi-bright nickels or the columnar structure that was important? In the case of one or two fairly large installations in the United States which used dual layer nickel, the under layer of semi-bright nickel did contain sulphur and had an undoubted columnar structure.

The Corrodkote test had been given a high rating in the Paper. It seemed eminently practicable in that the slurry was very reproducible and the humidity cabinet used was much more simple and commercially reproducible than any type of spraying mechanism such as a salt spray cabinet. As far as further work was concerned, the accelerated salt spray test was very widely used in the United States and had the merit of shortening the test by five times. His second suggestion for further work was a similar study, particularly a metallographic study, of the behaviour of dual or finely cracked chromium in regard to both surface life and the two principal accelerated tests described in the Paper.

During the discussion it would doubtless be said that, yet again, a copper undercoat appeared to be of no great assistance in regard to corrosion protection. He thought this depended very largely on the way the copper undercoat was used, and its general application.

T. E. Such (W. Canning and Co. Ltd.) thought that on the controversial problem of the correlation of accelerated corrosion tests with service performance the authors were right when they said that all tests now in common use were developed empirically and were only suitable as sorting tests. One must have very accelerated tests for checking production plated work—tests that would fail poorly plated articles in one or two days at most—in order to avoid a need for large stock-rooms where work was held in bond.

However, it was unfair to expect that the same tests, which gave rates of corrosion 500 to 1,000 times greater than occurred in service, should also reproduce the same mechanism of corrosion. As the authors said, "on outdoor exposure insoluble corrosion products such as basic sulphates are formed in the pits and these tend to stifle further attack." It was clearly evident, he said, that in tests such as the Corrodkote, which ate through 0·001 in. of nickel in 20 hr., only soluble corrosion products could be formed.

Roof tests had been criticized in the past for corroding plated articles far more quickly than in road service. This they did, but only by a factor of 5 to 10, not 1,000, and this was far more likely to reproduce the true mechanism of corrosion, by producing natural corrosion products, than were the present accelerated tests.

The chief objection to roof tests was that the conditions of exposure were not controllable. What was needed was a "not-so-accelerated-test" for use as a research tool rather than an acceptance test. The test should be designed to last about two months and be accelerated by three factors: (1) either keeping the surface continually moist, or perhaps alternating condensing and drying conditions; (2) using a higher temperature than ambient; (3) using slightly higher concentrations of corrodents than were met in service.

To illustrate the last point he would mention that 1 per cent of sulphur dioxide was used in the test as now laid down, compared with 0·00001 per cent in the air of large cities. Barton had recently suggested that 0·01 per cent would be better, as it reproduced the type of attack found in service. Such a test would be of great assistance to future work.

Dr. S. Wernick (Secretary) said that

The Corrosion of Decorative Nickel + Chromium Coatings: A Metallographic and Potential Study

By G. N. FLINT and S. H. MELBOURNE

THE morphology of pits in decorative nickel + chromium coatings resulting from service corrosion in an industrial atmosphere has been compared with that of pits produced in accelerated corrosion tests. Pit shapes characteristic of the early stages of service corrosion of semi-bright or bright nickel + chromium coatings in industrial atmospheres are reasonably well reproduced by exposure to the acetic acid/salt spray Corrodkote and SO_2 accelerated corrosion tests. Corrosion was characterized by formation of hemispherically shaped pits in the nickel layer: these occurred at discontinuities in the chromium top coat. The more irregular shape of pit frequently observed in nickel + chromium plating which has been in service for some years is not well reproduced by these accelerated tests.

In copper + nickel + chromium coatings, none of the accelerated tests gave close reproduction of the type of pit produced by corrosion in service. Contrary to service behaviour, the accelerated tests often corrode nickel in preference to copper. This feature is most marked in the SO_2 test, the results of which are, therefore, likely to give a misleadingly favourable impression of any protection provided by copper undercoats.

In double-layer nickel + chromium coatings, the acetic acid/salt spray and Corrodkote tests reproduce fairly closely the flat-based pits characteristic of service corrosion, which result from preferential corrosion of the bright nickel layer. Exposure of this type of coating to the SO_2 test results in formation of the hemispherically-shaped pits characteristic of single-layer nickel coatings. The SO_2 test is insensitive to the different activities of the two types of nickel and is not suitable for testing double-layer nickel coatings.

Deductions made on the basis of anode polarization measurements regarding the direction of preferential corrosion are in accord with the results of metallographic observations.

Further studies of anode and cathode polarization characteristics would provide a useful guide to the development of new tests capable of closely reproducing the form of corrosion observed in service.

Trans. Inst. Met. Fin., 1961, **38**, (2), 35.

Mr. W. E. Cattley, Mrs. G. Schofield and Mr. G. Schofield

Mr. B. E. Love, Mr. T. A. Bechtold, Mrs. B. E. Love, Dr. T. Stareck and Mr. C. F. Corfe

what emerged clearly was that there was preferential corrosion of the copper under the nickel coating, suggesting that the copper was a deleterious undercoating. He wondered whether, in fact, the authors would now really go so far as to say that on this evidence they would recommend that copper should, in fact, not be deposited on the metal.

Some people thought that if the copper were polished prior to being plated, it helped the corrosion resistance of the ensemble. Had the authors tried to ascertain the effect of different types of copper finishing prior to the application of the nickel deposit? What he had found most interesting in the copper section had been the relationship between the cyanide copper and the sulphate copper layers. In depositing on steel the cyanide bath came first, before the acid bath, but unfortunately it was the cyanide copper that appeared to be anodic to the sulphate. Had the reverse obtained it would have been a happy situation. Would it be helpful if one deposited first a flash of nickel, after which one could proceed with an acid bath rather than in the reverse direction?

The SO_2 test seemed inferior in its simulation to the accelerated salt spray and Corrodkote tests, and in view of its growing use it might be necessary to review its efficacy and further spread up and down the country. In the introduction the authors had said that porosity in the nickel layer was now generally discounted as a major cause of breakdown of nickel + chromium coatings. He would submit that this was a rather categoric statement. It might encourage a drift once again towards a reduction of nickel thickness, which would be deplorable.

H. Silman (Electro-Chemical Engineering Co. Ltd.) agreed with the authors that the corrosion products of copper accelerated the corrosion of nickel and chromium, but thought they were going too far if they deduced from this that the substitution of copper for nickel in deposits was under all conditions likely to be deleterious. Other factors influenced the durability of combined deposits, particularly structural aspects.

There was a good deal of experience of the value of a heavy buff copper deposit under a bright nickel layer. With a properly selected copper : nickel ratio, excellent results could be obtained but at this stage there was no evidence which would enable comparisons to be made between the durability of a heavy copper buff nickel deposit combined with bright nickel and the double nickel layer. All one could say was that the results were very good.

The photomicrographs indicated also that the form of attack at the boundary between the copper and the nickel layer was not so very different from that which took place between two nickel deposits.

In a test some years ago, copper was applied between two dull nickel deposits in the form of a sandwich. There was no doubt that such a combined deposit was extremely durable, in fact, more so than a single dull nickel deposit of the same total thickness.

Dr. S. Watson (International Nickel Co. (Mond) Ltd.) showed a number of slides illustrating the effect of corrosion on coatings that had been put on in the reverse order. As pitting increased, he said, one got preferential attack on the bright layer, which was now on the bottom; and the semi-bright layer was less attacked. Showing specimens exposed on the laboratory roof for six months, subjected to the acetic acid/salt spray test, or to the Corrodkote test, he added that from a sample exposed to service conditions—6½ months on the front of a van in Birmingham—it could be seen that the

Mr. E. F. Marlow, Mr. R. Fairfax-Naylor, Dr. A. Kellner and Mr. G. A. Moodie

Group including Mr. A. C. Benning and Mr. U. F. Marx

Group including Dr. S. Wernick and Mr. F. Willetts

Mrs. J. D. Beddows, Mr. M. J. Reidt, Miss E. Williams and Mr. F. W. Batty

inverted mushroom pit occurred under such conditions. What he had shown illustrated in another way the fact that the electrochemical deposits were all-important in double nickel layer coatings.

U. F. Marx (Wilmot Breeden Laboratories) said that practically all the micro-sections of semi-bright nickel deposits showed a nice columnar structure. An exception was Fig. 12, where the structure was broken up a little. Had the authors carried out any measurement of anode polarization which tended to differentiate between a columnar and a broken-up structure; in fact, had they attempted to relate the polarization to the age of the plating solution from which the sample was obtained? There was a certain amount of evidence that as a solution aged the nature of the deposit changed, and it would be interesting to know whether the polarization did too.

Dr. J. Edwards (B.N.F.M.R.A.), referring to the systematic exposure tests on laboratory-prepared specimens, asked whether the authors had noted the proportion of pits in the various coatings which penetrated to the basis metal, and tried to record the overall appearance of the different types of coating.

The work done on plated die-castings at B.N.F.M.R.A. had so far not demonstrated any appreciable advantage in corrosion resistance of duplex nickel over bright nickel. Often they were unable to distinguish, by a visual examination, between the two with the same chromium on the top. Evidence of superficial corrosion was not altogether absent. One could, in some cases, see it in a micro-section. Within six months of exposure at Euston the majority of pits had penetrated to the basis metal, resulting in blistering. A number of plated steel samples which he had shown as illustrating the benefits of nickel had had 20 or 30 pits/in^2, the pits being 0·020 in. or more across, whereas on other samples, where penetration to the basis metal was much delayed, there were hundreds, or even thousands, to the sq. in., and only a few thousandths of an inch across. Did the authors feel that the benefits of duplex nickel were most likely to be exhibited when the density of pitting was high?

A. H. Du Rose (Harshaw Chemical Co.) said that, in his experience, given low thicknesses, if one were to expose on a static exposure site, duplex nickel versus bright nickel, on either steel or die-castings, there would not be much to choose between them. Further to what Dr. Edwards had said, there would be a slight preference for duplex, but it would be very slight. However, when one went to actual service conditions it was quite different. It then appeared that duplex nickel had a definite advantage.

Just what was meant by "service conditions"? These could, of course, vary with location, particularly in the United States. Differing results could be obtained on the sea coast at a non-industrial site and, say, New York. Also, much depended on how frequently the panels were washed. One spoke of accelerated tests, roof static exposure tests and service tests, but there were various modifications of all of these. Reproduction of average service conditions had to be striven for.

Dr. T. P. Hoar (University of Cambridge) asked whether the authors had any idea why copper appeared to be more basic under these conditions than semi-bright nickel.

Dr. D. N. Layton (Ionic Plating Co. Ltd.), taking up Rose's point concerning washing, said that the chromium plating on mail delivery vans in Birmingham was quite good. They were washed each night by the drivers before being put away. This was extremely significant.

Had the authors any information on the importance of migration on thin section pressings which were nickel-chrome plated? This was commonly alleged to be a difficult application. Were there any quantitative data?

L. W. Harris (Morris Motors Ltd.) said that one of the commonest forms of

Mr. Palmer H. Langdon, Mrs. Palmer Langdon and Mr. T. A. Bechtold

Mr. and Mrs. B. Oade, Mr. C. F. Scarfe, Mr. G. Schmerling, Mrs. A. Walmsley and Mr. A. Walmsley

Group including Mr. J. Dixon, Mr. A. Walmsley and Mr. C. F. Corfe. *Mr. De J. Rudder, Mr. R. Brugger and Mr. F. Enrico*

breakdown in zinc alloy die-castings was blistering. The only microgroove in the Paper which related to a zinc alloy showed a rather broader type which did not look as if it would develop into a blister.

AUTHOR'S REPLY

G. N. Flint, replying, said that the work on accelerated corrosion tests was still proceeding, and the comments made would be very useful in planning future research. In regard to the copper undercoat story, he would emphasize that the tests carried out were primarily designed to ascertain the type of pitting which occurred. They had not, therefore, paid much attention to the actual performance rating of coatings on the samples exposed. The pits shown had been very carefully selected as typical. It was easy to produce a set of photomicrographs to support any story that one wished to tell. In order to give some idea of the variability of the type of pit that could be obtained they had taken a number of each type.

He did not know of a good explanation why copper was more basic than semi-bright nickel, but if one looked at the so-called galvanic series one saw that copper was there regarded as more basic. This had been deduced from the potentials measured in flowing sea water. In the latter, removal of copper corrosion products could occur, and in atmospheric corrosion there was removal of copper ions by precipitation, tending to make the copper more active. Also, he thought that nickel was more ennobled by exposure to oxygen than was copper. There were thus two reasons—one on the cathode side and one on the anode side.

So far as future work on accelerated corrosion tests was concerned, they were treating it as an electro-chemical problem. It was a matter of trying to accelerate the corrosion rate by a factor of something like 500 to 1,000 times. This could be done in several ways; either by decreasing cathode polarization or by making the cathode much more negative! The electrolyte resistance could be reduced or the anode made more active. The essential thing was to try to keep the factors in balance. The work that the Russians were doing on atmospheric corrosion was enormously important, and one could apply it to the accelerated corrosion tests. They had shown that it was cathode polarization that was the major controlling factor; but it could not be the only one or there would be no difference in the behaviour of undercoats. One had to remember that although one might multiply the rate by a factor of a thousand, one still had this controlling factor of cathode polarization. They hoped by this means to get the same form of attack. He did not know whether it would be necessary to introduce SO_2 or not.

Their experience with copper undercoat, and the "sandwiches" mentioned, was confined to the photomicrographs. They had shown that there was a difference between cyanide copper and acid copper. There was also some effect of bright copper. There were differences in the polarizability of bright and cyanide and sulphate coppers; so one could get a bright copper that would corrode fairly rapidly, but they had never noticed this in service. They had noticed the behaviour of bright copper deposits, but it had not had the same effect as double layer nickel deposits—it had not stopped penetration. They had had preferential attack of new copper but had not reduced the depth of penetration which was so characteristic of the double layer nickels in service. He would support Du Rose's comments regarding the service behaviour of the latter.

They had taken 40 or 50 road specimens and examined them metallographically. Nine or ten of the double layer nickels were characterized by the fact that they were pitted but did not show rust spots. They had seen few pits that had gone through to the base metals —perhaps because the surface exposure time had been relatively short—never more than two years. Here, again, one had the problem of rating the specimen. If one rated it by surface appearance only there was not much difference between single layer nickel and double layer nickel. If one rated it according to rust spots and penetration of the base there was a tremendous difference between the two.

So far as porosity was concerned, they had examined more than 1,000 pits and could recall seeing none in which this was the cause of breakdown: one could dismiss it as a major factor. The main cause was electrochemical corrosion, but porosity might well aggravate this.

Group including Mr. Sven Lovstedt, Mr. A. C. Benning and Mr. J. W. Weaver

RESUMÉ OF PROCEEDINGS AT CONFERENCE IN MOSCOW

Powder Metallurgy in Russia

HELD in Moscow, the fifth All-Union Conference on Powder Metallurgy was attended by some 400 delegates from different industries, research and development institutes, and from educational establishments. The Papers presented and discussed covered a very wide range of topics and were reprinted in *Vestnik Mashinostroeniya*.

Preparation of Powders

Professor A. I. Levin dealt with the theory of the electrolytic process used for the production of fine powders, and referred to the method of preventing the corrosion of these powders by using high molecular weight hydrophobic agents.

N. T. Kudryavtsev and N. I. Mikhailov reported on the electrolytic production of very fine iron powders used as additives in different types of adhesives, plastics and rubbers and described the details of the production process.

B. A. Borok and a number of investigators from the Central Scientific Research Institute for Ferrous Metallurgy presented Papers on the production and properties of alloy steel powders and of alloy powders based on iron, nickel, cobalt, titanium and other metals, on the production and properties of powder-metallurgical titanium, chromium and vanadium, on the production of titanium strip from the powdered metal, and on the investigation of hydrostatic pressing of metal powders and on the technique of manufacturing a molybdenum - aluminium alloy for thermocouples.

Sintering

Dealing with sintering, I. M. Fedorchenko and his collaborators pointed out that the most important problem in connection with the theory of the phenomenon is the elucidation of the mechanism of densification and shrinkage. Many investigators consider shrinkage to be the result of plastic flow and diffusion. The authors' experiments on the sintering of powders of silver, copper and nickel have shown that plastic flow manifests itself only when stresses are developed in the material being sintered by the application of external pressure. Shrinkage depends on diffusion, which, in turn, depends on the presence of a defective crystal structure, especially in the surface region of the particles of the powder. The properties of porous sintered bodies are determined by the density and the state of the inter-particle contacts, as well as by the condition of the surface of the pores.

M.Yu. Bal'shin confirmed that the general feature of processes of forming metal powder bodies is the equality between the nominal stress σ (expressed as a fraction of the contact stress σ_c) and the contact cross-section A_c (expressed as a fraction of the nominal cross-section A:

$$\frac{\sigma}{\sigma_c} = \frac{A_c}{A} = \alpha$$

where α is the contact cross-section expressed as a fraction of the nominal cross-section. The above expression applies, in general, as a first approximation. On the basis of this expression, the author has obtained a number of curves for cold and hot pressing, for sintering under pressure, for sintering in the absence of external pressure, etc.

The above expression was obtained by the author many years ago, but has now been confirmed to a sufficient degree of certainty. However, this theory, put forward by M.Yu. Bal'shin, was criticized by G. I. Aksenov. Professor G. I. Meerson suggested that shrinkage in sintering constitutes the main factor responsible for the increase in the properties of the sintered material. Consequently, the possibility of intensifying shrinkage is of considerable practical importance. He has achieved this by providing the particles of the starting powder in the case of a heterogeneous nickel-molybdenum alloy with a fine grained unstable structure, by cyclic variation of the sintering temperature in the case of titanium carbide, by recrystallization of titanium carbide in the presence of a liquid phase, and by activation of the surface of the particles by etching or washing. Professor Meerson criticized and rejected the claim by I. M. Fedorchenko and his collaborators regarding the absence of shear deformation in sintering and of any effect of surface defects of the particles on shrinkage.

A. P. Semenov, in a Paper dealing with the bonding of metals as a result of plastic deformation of the surfaces in contact, pointed out that, given an adequately clean surface, bonding occurs as an instantaneous non-diffusional process which is independent of time. It precedes the processes of diffusion and recrystallization.

B. M. Naumychev described the high-frequency sintering of bronze-graphite bushings without the use of a protective atmosphere. This method of heating for sintering shortens the process from the previous 4 hr. to 20-25 sec.

Compacting

G. I. Aksenov, in developing his previously published views, discussed some aspects of the theory of rolling metal powders (mechanism of deformation of the powder between the rolls, the forces involved in this mechanism, the influence of different factors on the roll angle) and put forward corresponding mathematical expressions for use in calculations relating to the engineering aspects of the process.

E. I. Langemass reported on the design of presses for metal powders. The designs for a 100-ton press have been completed and manufacture of the press has been started. This press has several advantages over the Stokes press, but its size and weight are still high, and the maximum height of the compacts is limited to 45 mm. The high cost of the press will also increase the cost of the metal powder products for which it is used.

Properties

In his Paper on the performance characteristics of heat-resisting, high-temperature materials produced by powder metallurgy using carbides, nitrides, borides and silicides, V. S. Rakovskii discussed the physical nature of such properties as heat resistance, thermal shock resistance, erosion resistance and mechanical strength, and indicated the direction of further research aimed at improving these properties. The same subject was discussed by G. S. Pisarenko in his Paper on the strength of metal powder materials based on the carbides of silicon and chromium. He discussed methods of testing these materials at high temperatures and the results obtained. Reference was made to the size factor, which influences the measurement of these properties.

A. N. Fillipov dealt with the properties of an aluminium-base bearing material containing 3·5 per cent iron, 2 per cent chromium, 1 per cent copper, 0·2 per cent titanium and 3-5 per cent graphite.

In their Paper on the investigation of the kinetics of the infiltration of porous bodies by molten metals, V. N. Eremenko and N. D. Lesnik dealt with the infiltration of iron, nickel and other metal powder bodies with copper, silver, lead and other metals, considering the cases in which solubility was absent, in which there was limited solubility, and that in which solubility occurred at different temperatures. They have calculated the wetting angles and energies of activation involved in the infiltration process and have derived equations for these processes.

A. D. Moshkov and V. V. Fedorov dealt with the passage of oil through pores in metal powder bearings. A numerical coefficient can be obtained on this basis as a measure of the porosity. It has been shown that bearings for use under light loads should have large values of this coefficient, while bearings operating under heavy loads should have small

values. An expression for calculating the value of the coefficient, and curves showing its relation to the original particle size of the powders and the porosity have been obtained.

Professor T. D. Vinnik presented the results of an investigation of the surface characteristics of pores in iron-base materials after turning. Conditions of turning, the influence of the geometry and material of the cutting tool and of the cutting medium on the surface finish have been investigated, and optimum machining conditions have been determined. I. M. Fedorchenko pointed out that his experiments have shown that much higher cutting speeds for optimum results are possible.

I. V. Kragel'skii and his collaborators dealt with metal powder-plastics friction materials developed on the basis of 75 per cent metal and 25 per cent barium sulphate, which materials have a coefficient of friction which remains constant with temperature.

Applications

O. V. Roman described the production of gears of oil pumps and other tractor parts by powder metallurgy.

A. P. Semenov described his observations, during a visit to this country, on the use of powder metallurgy for the production of plain bearings.

A. B. Al'tman and P. A. Gladyshev reported on the production of iron-nickel-aluminium permanent magnets by methods of powder metallurgy and the production of copper-base bearings.

V. S. Rakovskii dealt with new iron-base and copper-base friction materials suitable for use under arduous conditions in excavators and aircraft brakes where temperatures up to 1,200°C. could be reached.

V. K. Sorokin described the manufacture of porous filter elements by rolling from metal powders, the elements being intended for use in connection with the supply of liquids and gases in anti-icing devices for aircraft and for sweat-cooling. The relation between various factors and the permeability was discussed. E. I. Pavlovskaya and Z. V. Goryacheva also dealt with metal powder filters, their manufacture, and their economic and other advantages in the petroleum industry.

Refractory compounds, the production and uses of refractory materials based on carbides, borides, nitrides and silicides were dealt with by G. V. Samsonov and M. S. Koval'chuk.

The manufacture of metal powder filter elements from particles having a spherical shape obtained by melting in inert fillers was dealt with by I. M. Fedorchenko and A. P. Filatova.

Production experience in the manufacture of metal powder parts for the automobile industry at the Gorkii motor car works was dealt with by V. I. Blagin. V. V. Saklinskii also dealt with the use of powder metallurgy in the motor car industry. Its use in the Soviet Union dates back ten years. Its rapid rate of development is indicated by the rise in output from 2 tons in 1955 to 534 tons in 1959 and by the estimate of 3,280 tons in 1965.

Points of criticism made by some of the delegates included the still inadequate quality and purity of metal powders available, the desirability of speeding up the drafting of a standard specification for iron powders and the setting up of a centralized manufacture of presses, furnaces and mixing equipment as well as measuring and control instruments for the metal powder industries.

Among the recommendations made by the Conference was one relating to an early establishment of a central research institute for the industry and the publication of a journal devoted to powder metallurgy, the rapid development of equipment, in particular of automatic presses, high-temperature electric furnaces, grinding and mixing equipment, drying equipment for gases, etc. As regards scientific problems relating to powder metallurgy to be investigated in the immediate future, further work is required on the theory of sintering, on the problems of the strength of metal powder materials, the development of production processes for foamed metals, metal fibres, the rolling of powders, the manufacture of refractory materials, and on methods of manufacturing extremely finely divided powders of iron, nickel, chromium, tungsten, molybdenum and other metals.

Handling Large Parts For Plating

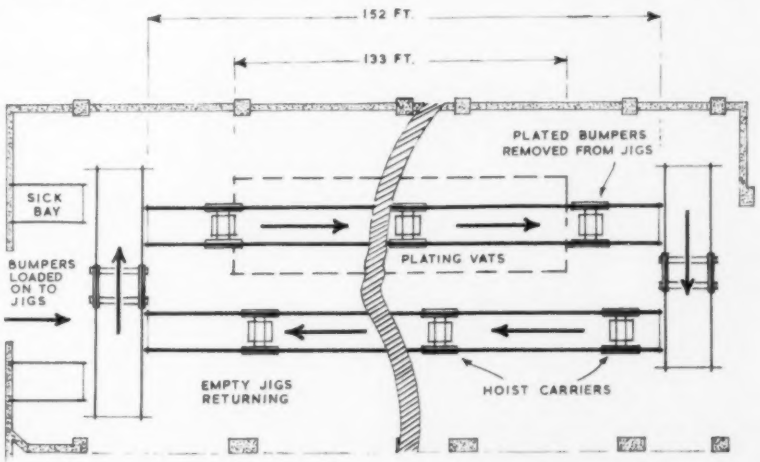
IN the plating section of their car bumper works at Amington Road, Birmingham, Wilmot Breeden Ltd. have introduced a new handling system for processing the bumpers through the plating cycle. The semi-automatic system is used in conjunction with a British MonoRail overhead runway and hoist installation, on which the bumpers, loaded on jigs in batches of up to twenty, pass through all the plating stages on a continuous cycle, without being removed from the system. Throughout the series of operations, each loaded jig is under the individual control of process operators.

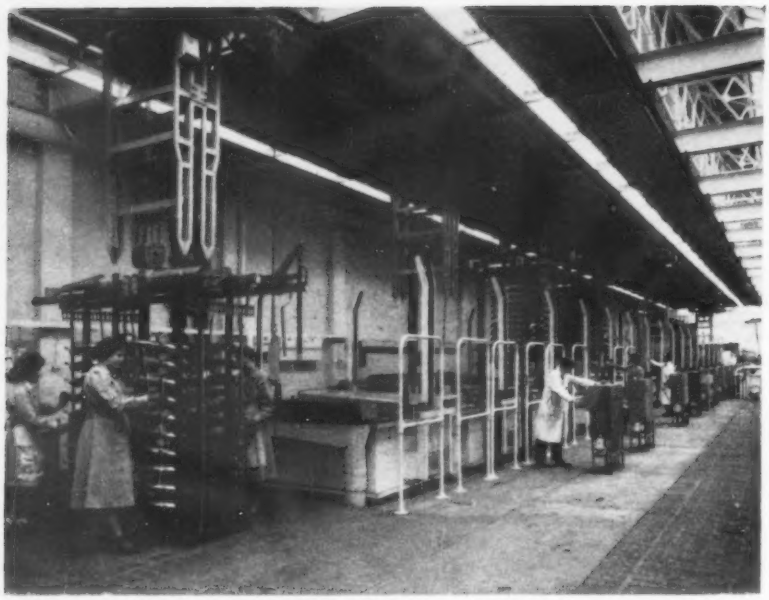
On arrival at the plating shop, bumpers are assembled on jigs, to which they remain attached until plating is completed, and then immersed in a plating sequence according to a strict time schedule. The need for accurate timing and maximum output makes it essential that the raising, lowering and transferring should be carried out speedily and smoothly.

The British MonoRail system which has been installed ensures this by providing a full circuit, with separate "out" and "return" lines of overhead dual runways some 152 ft. long, parallel with each other and connected at each end by a transfer crane section. Independent powered hoist carriers, with one-ton hoists attached, are suspended between the two rails of each runway. Pendant controls on each hoist carrier control the raising and lowering of the hoist, and the motion of the hoist carriers along the runways.

This installation permits a fully continuous handling system to be operated in the plating shop. Hoist carriers on the transfer section at the incoming end of the shop pick up loaded jigs, and are then brought into position to interlock with the plating line runway. They carry the loaded jigs along this line, stopping, raising and lowering at each

Diagrammatic representation of the plating section of Wilmot Breeden's car bumper works showing the layout of the British MonoRail installation





The British MonoRail system installed in the plating section of the car bumper works of Wilmot Breeden Ltd.

position under the control of process operators, in accordance with the plating schedule. At the end of the plating line, the jigs are lowered at an unloading station, where the bumpers are removed and the hoist carriers, with empty jigs attached, are run on to the other transfer section, interlocked on to the return line, and taken back to the start of the line, where the empty jig is detached and a filled one is picked up.

Power for the hoist carriers is provided on the runways by a set of conductor bars attached to one of the two rails and picked up by each carrier through shoes which run along these conductors. "Kant-Shock", a patented British MonoRail insulated sleeving, is fitted to prevent accidental contact by maintenance staff. Motion of the carriers along the runways is provided by an electric motor which drives a rubber-tyred wheel in contact with the underside of both of the runway rails.

Along the plating line, the speed of travel is 100 ft/min., the highest speed which will allow the operators close control of the position of the jigs, while on the return line the travel speed is increased to 200 ft/min.

The transfer section at the incoming end connects in addition with two short sections of dual runway, away from the main working area, known as "sick bays", to which hoist carriers and jigs may be run for maintenance or repair.

The entire handling system is located in the space above working height, leaving the floor free.

Friction Welding

IN friction welding, two metal, plastics or ceramic objects revolving or sliding in contact with one another weld together at the place of contact.

Early explanations held that friction welding is a variant of pressure welding and the weld is made during plastic deformation of the abutting surfaces. The two objects revolve or oscillate against each other until the heat of friction produces the temperature required for pressure welding. At this point, motion is stopped and the two pieces are held together by pressure to form a weld.

A more refined explanation of the process has now appeared, taking as its starting point the problem of uncovering the basic parameters under which the weld phenomenon takes place. A study of the records of the American Machine and Foundry Company laboratory friction welding machine produced data about the weld phenomenon in which one of the elements is the postulation of a layer of fluid metal formed at the interface of the two objects, particularly for the case of alloy steels. This layer acts as if it were a hydrodynamic thrust bearing or extreme pressure lubricant. Evidence of its existence occurs simultaneously with high quality welds in alloy steels and certain other metals.

Highly instrumented laboratory friction welder developed by the American Machine and Foundry Company

Obituary

Mr. Sidney Chatwin

IT is with the greatest regret that we have to record the death, on Saturday last, of Mr. Sidney Shilvock Chatwin, production manager of Johnson, Matthey and Company Limited, Vittoria Street, Birmingham. He had been with the company for 40 years and was mainly responsible, in the middle twenties, for the development of fire-free silver. Mr. Chatwin was a member of the Council of the Birmingham Metallurgical Society, and chairman-elect of the Birmingham Local Section of the Institute of Metals.

Mr. J. W. Ryde

WE also regret to record the death of Mr. John Walter Ryde, F.Inst.P., F.R.S., chief scientist of the Hirst Research Centre of The General Electric Company, Limited, Wembley, Middlesex. Mr. Ryde was elected a Fellow of the Royal Society in 1948.

Industrial News

Home and Overseas

Welding Technology

A copy of the new prospectus issued by the **Institute of Welding** is now available, in which is contained full details of courses to be held from October next to March 1962.

The School of Welding Technology makes available to the engineering industry a vast fund of technical information and managerial experience about all of the factors upon which the satisfactory and efficient application of welding depends.

Full particulars of the courses available may be obtained from the Institute at 54 Princes Gate, Exhibition Road, London, S.W.7.

Pneumatic Control

A new two-term pneumatic process control unit for use on batch processes is announced by **Honeywell Controls Ltd.** Designed to counteract "overshoot" on start-up, it is known as the Batch Air-O-Line and is suitable for use with electronic strip chart recorders and pressure gauges. This new unit will, it is stated, reduce or prevent overshoot by automatically discharging accumulated air when the pen moves out of the proportional band.

When the process is shut down, the controller output increases. When it reaches 15 lb/in^2, a bleed valve opens to exhaust the accumulated air, and the proportional band is simultaneously shifted downscale by blocking off the reset chamber. The controller output thus stays saturated during shut-down. On restart of the process, the reset chamber exhaust is shut and air returns to the reset chamber, reducing the controller output. The proportional band gradually shifts upwards and set point is reached without the usual cycling.

It is emphasized that the new technique does not slow the response of the process; the approach to the set point is simply made more gradual on start-up. Normal process control remains unaffected subsequently.

Long Service Rewards

On Thursday, June 8 next, thirty employees of the **Geigy Co. Ltd.,** all of whom have been with the firm for 25 years or over, will leave London by air for a long weekend in Switzerland, where they will be the guests of the management of the parent company, J. R. Geigy A.G., Basle.

Cladding of Steel Chimney Stacks

One of the more recent applications of aluminium in the building field is its use for the cladding of steel chimney stacks to overcome the specialized corrosion and smut emission problems which sometimes occur. Owing to the heat loss inherent in the use of an ordinary steel stack, an acidic solution condenses from the flue gases on the comparatively cool surfaces of the chimney and rapidly eats away the steel. The acid film also aggregates carbon particles, and these may be emitted periodically as acidic smuts.

Aluminium sheet used as a cladding acts as a thermal shield, keeping the chimney walls well above condensation point and so eliminating corrosion and smut emission. This is the primary effect but there are other advantages also. In an uninsulated steel stack the drop in temperature produces a corresponding drop in the velocity of the gas; by insulating with aluminium, a higher velocity is maintained and the flue gases are carried higher into the atmosphere and are thus more rapidly dispersed. In addition, the corrosion resistance of aluminium ensures that the stack is virtually maintenance-free and is made aesthetically more acceptable as an architectural feature.

The British Petroleum Co. Ltd. initiated the experiments which led up to this new process. The firm of F. E. Beaumont Ltd., steeplejacks and engineers, specialized in this kind of installation soon after its inception. This company first used aluminium as a thermal shield in May 1959, and since then has clad 180 stacks—about 1½ miles of chimney in all! The shield is in 16 gauge BA.60 alloy with the flange covers roll formed in super purity aluminium, both supplied by **The British Aluminium Company Limited.**

Meeting of Technologists

About 20 senior technologists from major battery and cable companies and research organizations in the U.K. attended a meeting recently in London, arranged by the **Lead Development Association,** to discuss those modifications to the mechanical properties of lead applicable to their industries.

Dr. J. E. Hughes, Chief Metallurgist of the A.E.I. Research Laboratories, Harlow, opened the proceedings by describing methods by which secondary additions can bring about changes in characteristics, with special reference to the lead-antimony system. The meeting welcomed Dr. Hughes's analysis, which was enlarged upon by Dr. E. J. Hooker, of Telephone Cables Ltd., who drew attention to anomalies in this system and added suggestions on their origin.

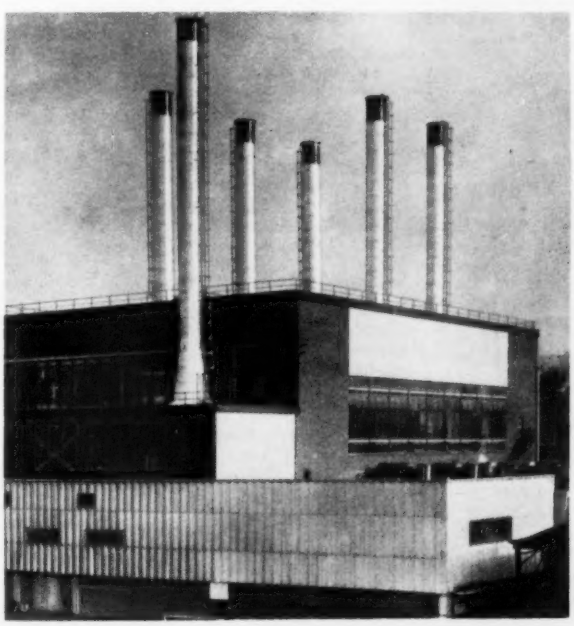
A wide ranging discussion by members developed during which Mr. N. E. Bagshaw, of Chloride Electrical Storage Co. Ltd., outlined the problems facing the battery industry, and Dr. A. J. Szper, of Varley Dry Accumulators Ltd., spoke on the difficulties encountered by small firms when fundamental research was required. Mr. E. A. Brandes, of Fulmer Research Institute, also mentioned the difficulties of segregation in the casting of cable billets and the possibilities of using nucleating agents, drawing examples from other alloy systems.

The meeting agreed that such discussion groups were of considerable value in appraising the results of current fundamental research and defining outstanding problems, and satisfaction was expressed at the announcement that the L.D.A. would hold such meetings more frequently in future.

A Tough Assignment

A difficult and tricky stud-welding operation using **Crompton Parkinson** equipment has recently been carried out at the Birmingham works of James Booth Aluminium Ltd. The application was concerned with the welding of reinforcement steel to sheet piling in the 148 in. rolling mill foundation for the extensions at the works.

Since the working of the rolling mill would cause a heavy vibration to be set up between the foundation and the piles, thus constituting a serious hazard, it was considered imperative to key the reinforced concrete foundation securely to the ⅜ in. thick piles, which had been driven round the majority of the 80 ft × 100 ft × 23 ft. excavations. ½ in × 16 in. long plain pins were welded *in situ* to the piles, which



Aluminium clad stacks at the A.D. Boiler House at Vauxhall Motors Ltd., Luton. They are clad in BA.60 sheet with flange covers roll formed in B.A. super purity

had been ground locally, and despite such handicaps as cleaning, the moving of scaffolding and waiting for craneage, a good rate of progress was maintained throughout the working day, an average of about 37 studs per hour.

As concrete pouring proceeds and the various reinforcements are fitted, these stud-welded plain pins will be bent *in situ* round the various reinforcing rods, thus giving a secure bond between the piles and the reinforced concrete foundation. The main contractor for the job is C. Bryant & Son Ltd.; Carter Worseley, of Tipton, are sub-contractors for the stud welding and the reinforced concrete design has been undertaken by British Reinforced Concrete Co.

Office Moves

At the end of this present month, the Middlesbrough branch of **Honeywell Controls Ltd.** will move from Fletcher Street to new premises at 59-60 Albert Road. The telephone number remains the same and the branch will continue to handle sales and service of industrial process controls and instrumentation, data processing equipment, automatic temperature and air conditioning controls.

Underground Cable Contract

A contract has been awarded to **British Insulated Callender's Cables Limited** by the Central Electricity Generating Board for the supply and installation of 132,000-volt underground cables in the London area. The contract, valued at approximately £1,750,000, will provide a major power link between the C.E.G.B. Terminal Tower at Lessness, Belvedere, and their sub-station at Wimbledon. The cable route is about 19 miles.

The installation will comprise two circuits, each of three single-core oil-filled cables, with 0·75 in^2 copper conductors. One of the circuits will be sheathed with corrugated seamless aluminium and the other with reinforced lead.

Standard-Sized Bearings

In 1948, the **Glacier Metal Company Ltd.** pioneered a range of standard bearings and anti-friction material so that the needs of a wide variety of industries could be immediately met on an "off the peg" basis. At the present time there is a continuous stock of 114 inch sizes and 137 standard metric sizes of wrapped bushes, 104 standard sizes of finished machined bronze bushes, 65 inch sizes and 50 standard metric sizes of dry bearings.

Orders for the above can be made in units from one to 1,000,000, and so doing offers the advantage of time saved in the drawing office; the work of the buyers is reduced to a minimum; there is no delay in sending quotations or waiting for delivery; and last, but by no means least, manufacturers themselves can work on a minimum stock.

Tin Shipments

Malayan tin shipments in the first half of May amounted to 2,739¼ tons from Penang and 347½ tons from Singapore, according to the Straits Trading Company. This compares with respective amounts of 2,358½ tons and 223¼ tons in the first half of April.

The latest figures comprised the following shipments (all in tons). From Penang: 525 to U.S., 1,182 to Continent, 70 to Canada, 461 to Japan, 4 to Pacific, 202¼ to India, 135 to South America, 25 to Africa, 135 to Australasia. From Singapore: 115 to U.S., 115 to Continent, 1 to Pacific, 6½ to India, 95 to South America, 15 to Australasia.

The new Midlands depot of the Electro-Chemical Engineering Co., Ltd., at Witton

New Midlands Depot

Readers may remember that in last week's issue (page 401), mention was made of the new depot for **Electro-Chemical Engineering Company Ltd.**, which has been opened at Moor Lane, Witton, Birmingham. We are able on this page to give an illustration of the new buildings which will enable the company to provide improved services and supplies for plating shops and trade platers in the Midlands.

The main stores at Witton are now located in one large building, 115 ft. long, 47 ft. wide, and 17 ft. 6 in. to the roof trusses, about a quarter of the structure being on two floors. The offices are on the first floor of the administrative block, with lock-up store-rooms on the ground floor. These rooms at present open into the main stores, but are arranged for conversion into offices when required.

The depot stocks heat-treatment salts, stopping-off compound and other consumable products of **Efco Furnaces Ltd.**, and also a wide range of furnace spares for the maintenance of Efco furnace installations in the Midlands area.

British Aluminium Expansion

Important plans for the extension of its Falkirk rolling mills are to be put into operation by **The British Aluminium Company Limited.** Over £10,000,000 is to be spent on new equipment for the mills and the first stage comprises a hot rolling mill approximately 172 in. wide, which will give the company the widest aluminium rolling mill in the world. It will treble the Falkirk ultimate capacity to 150,000 tons annually.

Work is to commence at once, and cold rolling and finishing capacity will be increased to absorb the hot rolling capacity over a succeeding period as the growing market for aluminium warrants. The company anticipates that aluminium usage will grow by at least twice the national average rate of industrial growth and, in particular, in markets such as packaging, transport, building and household appliances, the rate should be even higher.

The British Aluminium Company is facing a large and rapidly expanding export business, and this additional facility will enable it to remain fully competitive in world markets.

Technical Training Week

On Monday next, May 29, **Commonwealth Technical Training Week** will commence, and activities have been organized not only in London but in all the large industrial centres in the country, in which local authorities, technical colleges, youth services and the like are all taking part.

In London, the Royal Exchange Exhibition will cover banking, insurance, public service, the R.A.F., surveying, civil engineering, mechanical engineering, electrical engineering, and such other industries as foundry, aluminium, copper, iron and steel, printing, packaging, heating and ventilating, transport, oil and coal industries. The three services are also contributing to the week.

A Sales Conference

A national sales conference was held recently at the Great Northern Hotel in London by **Stedall and Company Ltd.**, distributors of "Rust-Oleum", the rust preventive process. The chairman, Lt.-Col. H. S. O. P. Stedall, O.B.E., spoke of the excellence of the company's product which is sold to industrial users having rust problems. A sales competition for the product was announced under the name of "Rust-Oleum Sales Stakes".

Induction Heating Courses

Since they started their induction heating courses, **Pye Limited** have received a steady flow of enquiries. They have now arranged the date for the next course, which will be held at the Globe Hotel, Cambridge, commencing on Tuesday, October 3, and finishing at 5.30 p.m. the next day. The course will cover the fundamentals of induction heating, annealing and tempering of small parts, brazing, soldering and processing of conducting materials.

There are no fees, and full details may be obtained from Mrs. E. Raeburn, Pye Process Heating, 28 James Street, Cambridge.

International Copper

Members of the Copper Development Directors Committee met recently at Folkestone for their 11th meeting. Representatives from Belgium, Canada, Denmark, France, Germany, Italy and Switzerland were present at the meeting, and the agenda of each day's conference included a variety of technical and administrative matters of mutual concern to each of the centres in their furtherance of the efficient development and use of copper and its alloys.

A tour of places of local interest was included during the week of the meeting, and these were organized by the Copper

Development Association of Great Britain. During the course of the meeting, the formation of a Copper Development Centre in Australia was announced.

Anniversary Celebration

To mark the occasion of its 75th anniversary, **The British Oxygen Company Limited** has made a film called "O for Oxygen". It shows how from Priestley's discovery of oxygen in 1774 has stemmed a world wide use for oxygen and other industrial gases in industry, medicine, aviation and scientific development. It also illustrates how the various ingredients of the air are being used to make steel more efficiently, cut ships' plates more quickly and more accurately, weld metals more strongly, to send up rockets and to save lives.

Made for general interest by World Wide Pictures Ltd., "O for Oxygen" is photographed in Eastman colour, printed by Technicolor, and runs for 23 minutes. Copies of the film in 16 mm. and 35 mm. will soon be available on free loan from B.O.C. to schools, colleges and similar organizations.

A Link-up

It is announced that **R. Cruickshank Limited** has now joined the Forestal group of companies. This acquisition forms an extension of the programme of diversification into the chemical manufacturing industry which is being carried out by Forestal.

It is intended that the considerable technical resources of Forestal shall be applied to extending the range of products and the level of technical service provided by R. Cruickshank Limited. It is hoped that the substantial manufacturing capacity of the Forestal plants throughout the world will improve the competitive position both at home and in overseas markets. The company will continue under the guidance of Mr. A. J. L. Nash as managing director, and the name of the company will remain unchanged.

Representatives Appointed

Augmenting their outside staff and improving the contact between themselves and customers in the Midlands and Scotland, **Hilger and Watts Ltd.** have recently appointed two more representatives.

Mr. E. R. Sayer, B.Sc., Ph.D., has been appointed to cover the Midlands and will be located at 32 Mountford Crescent, Aldridge, Staffs. His area will include Staffordshire, Derbyshire, Nottinghamshire, Warwickshire, Leicestershire, Northamptonshire, Gloucestershire, Herefordshire, all Wales apart from Flintshire, and the towns of Banbury and Crewe.

For Scotland they have appointed Mr. Alastair Campbell, B.Sc., whose base will be the offices of Elesco Electronics Ltd., 2 Fitzroy Place, Glasgow, C.3. These two gentlemen join Mr. D. G. Heywood, A.Met., who for some years has represented the company in the North of England and is located in Sheffield.

Institute of British Foundrymen

CHELTENHAM was the venue for the annual general meeting of the Institute of British Foundrymen, which was held at the Town Hall on Tuesday of last week under the chairmanship of **Mr. G. R. Shotton,** the retiring President.

After the minutes of the previous meeting had been approved, also the annual report, financial statement and report of the technical committee approved, the President presented the following awards:—

Honorary Membership: election of **Mr. S. H. Russell** and **Mr. J. J. Sheehan,** in recognition of their sterling work for the Institute over a period of many years.

E. J. Fox Medal: To **Mr. J. E. V. Jobson,** in recognition of the outstanding contributions he has made to the progress of the foundry industry.

Oliver Stubbs Medal: To **Mr. Jack Hill,** in recognition of his considerable contributions to the knowledge of foundry practice and the many Papers he has presented to the Institute on this subject, also for his valuable work in the field of foundry education.

Meritorious Services Medal: To **Mr. J. H. Pearce** in recognition of his devoted service as branch secretary for many years, and of his work on various standing committees, including in particular, the education committee.

The President then invited **Mr. F. Barrington Hooper** to present the British Foundry Medal to **Mr. J. M. Middleton,** and the British Foundry Prize of £10 to **Mr. P. J. McIlroy** in recognition of the excellence of their joint Paper, "Mould Paints and Washes for Steelfoundry Use".

Awards of Diplomas for 1961 were then made by the President to the following: **Mr. B. R. Douglas** for his Paper, "The Uncooled Basic Cupola"; **Mr. H. A. Stephens** for his Paper "Moulding-Sand Practice in Australia", and **Dr. R. V. Riley** for his Paper "Thoughts on Phosphoric Cast Iron".

Election of officers for 1961-62 was then announced as follows: President, **Mr. D. A. Richards;** Senior Vice-President, **Mr. G. R. Webster;** Junior Vice-President, **Mr. R. F. Horton.** Five members were elected to the Council as follows: **Dr. H. T. Angus, Mr. N. Charlton, Mr. M. Hallett, Mr. H. Paton Millar,** and **Mr. A. P. Riley.**

The annual general meeting having been concluded, the Presidential address was given by **Mr. D. A. Richards,** and this was followed by the "Edwards Williams Lecture", which was given by **Mr. N. P. Newman,** C.B.E., J.P., who took as his subject "Leadership in Management". A vote of thanks was then accorded to Mr. Newman.

The annual banquet was held in the evening at the Town Hall, under the chairmanship of **Mr. D. A. Richards,** President of the Institute. After the Loyal Toasts had been honoured, **Mr. G. R. Shotton** proposed the toast of "The Mayor and Corporation of Cheltenham", and this was replied to by **Alderman C. G. Irving,** Deputy Mayor of Cheltenham. The toast of "The Institute" was proposed by the **Rt. Hon. Lord Mills,** K.B.E., Paymaster-General, and response was made by the President. The concluding toast of "The Guests" was proposed by **Mr. G. R. Webster,** Senior Vice-President of the Institute, and replied to by **Maj.-Gen. G. L. Watkinson,** D.S.O., D.L., joint managing director of Stothert and Pitt Ltd.

Men and Metals

It has been announced by Davy-Ashmore Limited that **Mr. C. E. Wrangham** has retired from the boards of the company and its subsidiaries.

Two new directors have been appointed to the Metals Division of Imperial Chemical Industries Limited. They are **Mr. T. H. Gallie,** to be overseas director, and **Mr. J. R. H. Crane** to be director, copper products. Mr. Gallie has been concerned with metal

T. H. Gallie

J. R. H. Crane

sales throughout his 25 years' service with the company, and for the past two years has been metal sales manager, Midland Region. Mr. Crane joined the Division in 1939 as a laboratory assistant, became titanium production manager, and in 1959 was transferred to Lightning Fasteners Ltd. as general manager.

Officers of the Birmingham Metallurgical Society for 1961-62 have been elected as follows:—President: **Mr. S. Heslop;** Vice-Presidents: **Mr. E. J. Bradbury, Dr. W. O. Alexander, Mr. P. F. Hancock,** and **Dr. I. G. Slater.** The following members were elected to the Council: **Mr. L. C. Batchelor, Mr. A. W. Franklin, Mr. H. Gilbert,** and **Mr. H. A. Snow.**

At the annual general meeting of the Institution of Metallurgists, held in London last week, it was announced that **Dr. N. P. Allen,** M.Met., D.Sc., F.I.M., F.R.S., superintendent of the Metallurgy Division, National Physical Laboratory, had been elected President of the Institution for the year 1961-62 in succession to **Mr. W. E. Bardgett,** B.Sc., A.M.I.Mech.E., F.I.M. The following elections were also made: **Dr. E. G. West,** B.Sc., Ph.D., F.I.M. (Senior Vice-President); **Mr. F. Dickinson,** B.Sc., F.Inst.P., F.I.M., and **Dr. L. Northcott,** Ph.D., D.S.C., F.R.I.C., F.I.M. (Vice-Presidents); **Mr. H. Morrogh,** F.I.M., **Mr. S. S. Smith,** M.Met., F.I.M., and **Dr. J. C. Wright,** members of council; and **Mr. L. M. Derry,** B.Sc., M.Sc., F.I.M., to be hon. treasurer.

Arrangements made for the ensuing year at the annual general meeting of the National Association of Non-Ferrous Metal Merchants' Golfing Society, held last week, were as follows: **Mr. H. G. Shields,** President; **Mr. J. E. Lisle,** captain, and **Mr. L. E. Ricketts,** treasurer.

Metal Market News

THE April copper statistics issued by the Copper Institute, which became available at the beginning of last week, made a good impression in view of the sharp decrease in stocks and the fall in the production of refined copper. Details, shown in short tons of 2,000 lb., are as follow: Inside the United States the output of crude copper was 106,611 tons and of refined 128,440 tons, both these figures being below the March totals, the former by 2,000 tons and the latter by nearly 24,000 tons. Deliveries of refined copper to consumers, at 125,905 tons, were up by 13,500 tons, but stocks of refined copper in producers' hands at April 30, at 114,247 tons, were 25,000 tons lower than at March 31. Outside the United States, stocks showed, however, little change, for the April figure, at 333,151 tons, was only about 4,350 tons lower than March. Deliveries dropped from 207,882 tons in March to 198,835 tons in April, while output of refined copper at 164,886 tons compared with 187,220 tons in March. Production of crude copper declined from 217,633 tons to 202,013 tons. Coming to more local figures, the Metal Exchange stocks at the beginning of last week showed a further gain of 410 tons in the reserves of copper to 16,067 tons, while zinc stocks also showed an advance of 354 tons to 6,578 tons. In tin and lead, however, the trend was the other way, for there was a fall in the tin tonnage of 282 tons to 9,334 tons, while lead dropped back by 85 tons to 11,879 tons.

In view of the approaching Whitsun holiday, the metal markets were surprisingly active and, on the whole, made quite a good show. On balance, lead and zinc showed little change, but prices were inclined to ease; tin and copper, on the other hand, while closing below the best, were substantially above the previous Friday's close. Copper was, of course, very much helped by developments in the United States, where before the week ended the producers and custom smelters alike had raised their selling limit to 31 cents. Since the price of copper is now substantially above £240, which is the level usually regarded as the aim of the producers, consumers are a good deal disappointed that nothing has been heard of any intention to return to a normal rate of output at the mines. The statistics detailed above appear to make nonsense of the idea that there is still a condition of over-production, and many people are beginning to feel that if a runaway market is to be avoided, the sooner production cuts are restored the better.

This appears to be particularly necessary if it is remembered that strikes threaten in the United States and in Chile. Whether or not a stoppage will occur is uncertain, but the hiatus in production might well be of many weeks' duration. As already mentioned, trading last week was quite active, the turnover in copper being about 14,750 tons up to the midday trading session on Friday, when business ceased until last Tuesday morning. On balance, cash and three months closed £2 10s. 0d. higher at £244 15s. 0d. and £245 15s. 0d., both these quotations being below the best. About 1,000 tons of tin changed hands, cash closing £8 up at £868, and forward £6 10s. 0d. better, at £871 15s. 0d. These prices were about £5 below the best seen during the week. On a turnover of 7,650 tons, lead lost 5s. cash and 10s. forward to close at £66 12s. 6d. and £67 17s. 6d. Some 6,750 tons of zinc were traded, both positions losing 5s. at £81 17s. 6d. cash and £82 5s. 0d. three months.

Birmingham

Trade activity has been quieter this week, owing to the Whitsuntide holiday, but the general tone of the metal industries remains satisfactory. Unemployment has been considerably reduced since the beginning of the year and the short time working which prevailed in some industries, particularly the motor trade and those closely allied to it, has been eliminated. In fact, overtime has been resumed in a number of factories to cope with increasing orders. A marked expansion of business has taken place in the machine tool trade, work having been booked to ensure full employment over many months.

There are indications that stocks of iron and steel have been reduced considerably amongst consumers, and this is bringing out some forward buying. On the other hand, greater steelmaking capacity means that users are not having to wait long periods for delivery. Firms supplying raw material for the motor trade are well situated for work. Pressure for steel for building is as heavy as ever, and there are delays in obtaining delivery of reinforcing rods and bars. Plate mills could take on more work. A big increase has taken place in consumption of pig iron for foundry work, but the capacity of the furnaces is more than equal to the demand.

New York

Copper futures were active and firmer at the week-end. Prices ranged to more than 25 points higher on trade and speculative buying which reflected the 1 cent boost in scrap copper and the higher London market. Physical copper was firm. Custom smelters were booking a fairly good business for June at the monthly average. Rumours continued to persist that some custom smelters business was being done at 32 cents/lb. Scrap was tightly held at the 27.25 cents/lb. level.

Tin was easier, pricewise, following similar action in the East and London, but little or no business was reported as dealers were hesitant pending the holiday on the Continent and the International Tin Council meeting. Lead and zinc were quiet.

Japan

The Japan Mining Association has reported that foreign countries were urging Japan to increase imports of non-ferrous metals and hold down purchases of ores and scraps. Foreign delegates were critical of Japan's importing methods at the International Lead and Zinc Study Group meeting held in Mexico City in March this year, the Association said. It was alleged that these methods were disrupting the international market for raw materials.

The Association also said foreign countries were unofficially suggesting that Japan should liberalize the imports of electrolytic copper and reduce the import duty on it. It said Japanese non-ferrous metal industries were making their best efforts to put imports of ores and scraps on a long-range basis and conduct joint development of overseas non-ferrous ore resources. Japan's imports of non-ferrous metal ores and scraps had been rising sharply in recent years owing to mounting requirements from both manufacturers of capital goods required for economic expansion and makers of durable consumer goods.

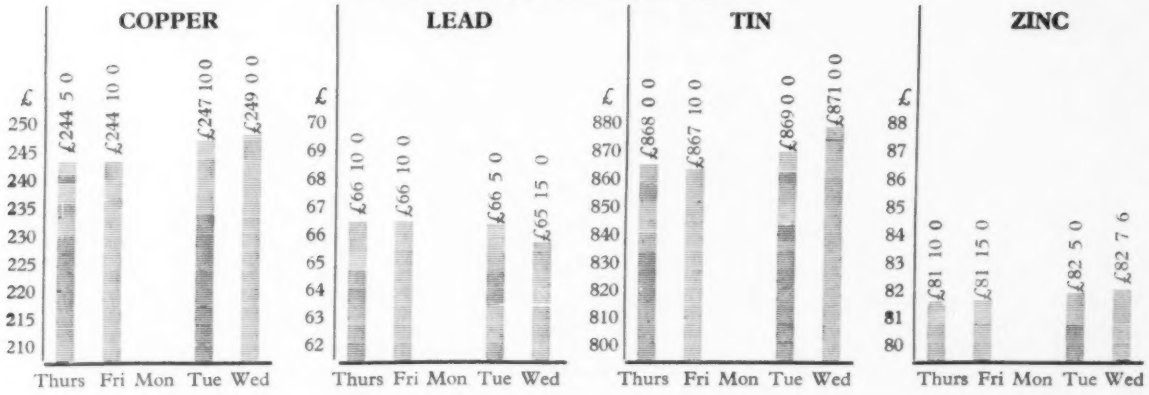
The Association also said Japanese copper smelters were now importing nearly half of the copper ores available in the international market. Imports rose from 45,000 tons in the 1958 financial year (April to March) to 108,000 tons in the 1960 financial year, and were expected to reach 130,000 tons in the current financial year. Imports of lead ore also rose from 27,000 tons in the 1958 financial year to 42,000 tons in the 1960 financial year, and were likely to amount to 60,000 tons in the current financial year. Zinc ore imports this year were expected to total 140,000 tons, compared with 65,000 tons in 1959.

It was added by the Association that heavy imports of copper-base scrap alloys might have been partly responsible for the recent increases in the United States copper prices, but the effects of the international situation and recovery in United States business conditions could not be ignored.

Non-Ferrous Metal Prices

London Metal Exchange

Thursday 18 May to Wednesday 24 May 1961



Primary Metals

All prices quoted are those available at 2 p.m. 24/5/61

		£	s.	d.
Aluminium Ingots	ton	186	0	0
Antimony 99·6%	,,	237	10	0
Antimony Metal 99%	,,	230	0	0
Antimony Oxide Commercial	,,	194	10	0
Antimony White Oxide	,,	212	0	0
Arsenic	,,	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	,,		11	0
Calcium	,,	2	0	0
Cerium 99%	,,	15	0	0
Chromium	,,		6	11
Cobalt	,,		12	0
Columbite	per unit		8	10
Copper H.C. Electro	ton	249	0	0
Fire Refined 99·70%	,,	248	0	0
Fire Refined 99·50%	,,	247	0	0

		£	s.	d.
Copper Sulphate	ton	80	0	0
Germanium	grm.		—	
Gold	oz.	12	11	11
Indium	,,		10	0
Iridium	,,	24	0	0
Lanthanum	grm.		15	0
Lead English	ton	65	15	0
Magnesium Ingots	lb.			
99·8%	,,		2	2½
99·9+%	,,		2	3
Notched Bar	,,		2	9½
Powder Grade 4	,,		5	6
Alloy Ingot, AZ91X		1	11¾-2	1¼
Manganese Metal	ton	280	0	0
Mercury	flask	67	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	,,		5	6
Osmium	oz.	20	0	0
Osmiridium	,,		—	

		£	s.	d.
Palladium	oz.	9	0	0
Platinum	,,	30	5	0
Rhodium	,,	46	0	0
Ruthenium	,,	16	0	0
Selenium	lb.	2	6	6
Silicon 98%	ton	123	0	0
Silver Spot Bars	oz.		6	7⅜
Tellurium Sticks	lb.	2	0	0
Tin	ton	871	0	0
***Zinc**				
Electrolytic	ton		—	
Min 99·99%	,,		—	
Virgin Min 98%	,,	82	11	3
Dust 95/97%	,,	125	0	0
Dust 98/99%	,,	131	0	0
Granulated 99+%	,,	107	11	3
Granulated 99·99+%	,,	122	6	3

**Duty and Carriage to customers' works for buyers' account.*

Foreign Quotations

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg≏£/ton	**Canada** c/lb≏£/ton	**France** fr/kg≏£/ton	**Italy** lire/kg≏£/ton	**Switzerland** fr/kg≏£/ton	**United States** c/lb≏£/ton
Aluminium		26.00 210 12	2.43 179 11	370 216 1	2.50 210 5	26.00 207 4
Antimony 99.0			2.80 206 18	520 303 13		32.50 259 0
Cadmium			16.25 1.200 17			160.00 1,275 4
Copper						
Crude				460 269 12		
Wire bars 99.9						
Electrolytic	33.00 241 3	28.75 232 17	3.32 245 6		2.85 239 13	30.00 239 2
Lead		10.00 81 0	.96 70 18	167 98 10	.80 67 5	11.00 87 13
Magnesium						
Nickel		70.00 567 0	9.00 665 2	1,180 689 2	7.50 630 15	74.00 589 15
Tin	119.75 875 5		12.13 896 8	1,600 944 8	10.30 866 4	109.75 874 14
Zinc						
Prime western		12.25 100 4 0				
High grade 99.95		12.85 104 17 0				
High grade 99.99		13.25 107 6 0			1.05 98 6	
Thermic			1.23 90 17			
Electrolytic			1.31 96 16	189 110 7		13.00 104 0

Non-Ferrous Metal Prices (continued)

Ingot Metals

All prices quoted are those available at 2 p.m. 24/5/61

	£	s.	d.
Aluminium Alloy (Virgin)			
B.S. 1490 L.M.5 .... ton	210	0	0
B.S. 1490 L.M.6 .... „	202	0	0
B.S. 1490 L.M.7 .... „	216	0	0
B.S. 1490 L.M.8 .... „	203	0	0
B.S. 1490 L.M.9 .... „	203	0	0
B.S. 1490 L.M.10.... „	221	0	0
B.S. 1490 L.M.11.... „	215	0	0
B.S. 1490 L.M.12.... „	223	0	0
B.S. 1490 L.M.13.... „	216	0	0
B.S. 1490 L.M.14.... „	224	0	0
B.S. 1490 L.M.15.... „	210	0	0
B.S. 1490 L.M.16.... „	206	0	0
B.S. 1490 L.M.18.... „	203	0	0
B.S. 1490 L.M.22.... „	210	0	0
Aluminium Alloys (Secondary)			
B.S. 1490 L.M.1 .... ton	161	0	0
B.S. 1490 L.M.2 .... „	162	0	0
B.S. 1490 L.M.4 .... „	171	0	0
B.S. 1490 L.M.6 .... „	177	0	0
***Aluminium Bronze**			
BSS 1400 AB.1..... ton	258	0	0
BSS 1400 AB.2..... „	266	0	0

	£	s.	d.
***Brass**			
BSS 1400-B3 65/35 .. ton	187	0	0
BSS 249 ..... „		—	
BSS 1400-B6 85/15 .. „	235	0	0
***Gunmetal**			
R.C.H. 3/4% ton .... „		—	
(85/5/5/5) LG2 ..... „	234	0	0
(86/7/5/2) LG3 ..... „	244	0	0
(88/10/2/1) ..... „	297	0	0
(88/10/2/½) ..... „	306	0	0
***Manganese Bronze**			
BSS 1400 HTB1.....' „	204	0	0
BSS 1400 HTB2..... „	222	0	0
BSS 1400 HTB3..... „	341	0	0
Nickel Silver			
Casting Quality 12% „	260	0	0
„ „ 16% „	270	0	0
„ „ 18% „	310	0	0
***Phosphor Bronze**			
B.S.1400P.B.1.(A.I.D. released) ..... „	326	0	0
B.S. 1400 L.P.B.1 „	256	0	0

**Average prices for the last week-end.*

	£	s.	d.
Phosphor Copper			
10% ..... ton	271	0	0
15% ..... „	274	0	0
Phosphor Tin			
5% ..... „	952	0	0
Silicon Bronze			
BSS 1400-SB1 ..... „	298	0	0
Solder, soft, BSS 219			
Grade C Tinmans ... „	396	0	0
Grade D Plumbers .. „	315	10	0
Grade M ..... „	436	5	0
Solder, Brazing, BSS 1845			
Type 8 (Granulated) lb.		—	
Type 9 „ „		—	
Zinc Alloys			
BSS 1004 Alloy A .. ton	115	16	3
BSS 1004 Alloy B.... „	119	16	3
Sodium-Zinc ..... lb.		2	7

Semi-Fabricated Products

Prices vary according to dimensions and quantities. The following are the basis prices for certain specific products.

Aluminium				
Sheet	10	S.W.G. lb.	2	10½
Sheet	18	S.W.G. „	3	0½
Sheet	24	S.W.G. „	3	3½
Strip	10	S.W.G. „	2	10½
Strip	18	S.W.G. „	2	11½
Strip	24	S.W.G. „	3	1
Circles	22	S.W.G. „	3	4½
Circles	18	S.W.G. „	3	3½
Circles	12	S.W.G. „	3	2½
Plate as rolled ..... „			2	10
Sections ..... „			3	4
Wire 10 S.W.G. .... „			3	1½
Tubes 1 in o.d. 16 S.W.G. ..... „			4	4
Aluminium Alloys				
BS1470. HS19W.				
Sheet	10	S.W.G. „	3	3
Sheet	18	S.W.G. „	3	5½
Sheet	24	S.W.G. „	4	1
Strip	10	S.W.G. „	3	3
Strip	18	S.W.G. „	3	4½
Strip	24	S.W.G. „	4	0½
BS1477. HP30M.				
Plate as rolled ..... „			3	1
BS1470. HC15WP.				
Sheet	10	S.W.G. „	4	3
Sheet	18	S.W.G. „	4	8½
Sheet	24	S.W.G. „	5	8½
Strip	10	S.W.G. „	4	4
Strip	18	S.W.G. „	4	8½
Strip	24	S.W.G. „	5	4½
BS1477. HPC15WP.				
Plate heat treated ... „			3	10½
BS1475. HG19W.				
Wire	10	S.W.G. „	4	2
BS1471. HT19WP.				
Tubes 1 in. o.d. 16 S.W.G. ..... „			5	5
BS1476. HE19WP.				
Sections ..... „			3	4
Split tube				
19 S.W.G. (¼") ..... „			4	2
20 S.W.G. (⅜") ..... „			3	11
21 S.W.G. (⅜") ..... „			4	1
22 S.W.G. (½") ..... „			4	11
Welded tube				
14 to 20 S.W.G. (sizes ½" to 1½") .... „			3/10½ to 5/8½	

Brass				
Tubes ..... lb.			1	11½
Brazed Tubes ..... „			3	3½
Drawn Strip Sections „			3	3½
Sheet ..... ton	210	0	0	
Strip ..... „	210	0	0	
Extruded Bar ..... lb.			2	1¾
Condenser Plate (Yellow Metal)..... ton	195	0	0	
Condenser Plate (Naval Brass) ..... „	208	0	0	
Wire ..... lb.			2	9½
Beryllium Copper				
Strip ..... „		1	4	11
Rod ..... „		1	1	6
Wire ..... „		1	4	9
Copper				
Tubes ..... lb.			2	4½
Sheet ..... ton	283	15	0	
Strip ..... „	283	15	0	
H.C. Wire ..... „	294	15	0	
Cupro Nickel				
Tubes 70/30 ..... lb.			3	7½

Lead				
Pipes (London) ..... ton	107	0	0	
Sheet (London) ..... „	104	15	0	
Tellurium Lead ..... „	£6 extra			
Nickel Silver				
Sheet and Strip 10%.. lb.			3	11½
Wire 10% ..... „			4	4¼
Phosphor Bronze				
Wire ..... „			4	3½
Titanium (1,000 lb. lots)				
Billet 4½" to 18" dia..... lb.		47/-		48/-
Rod ¼" to 4" dia..... „		85/-		53/-
Wire ·036"-·232" dia.... „		159/-		99/-
Strip ·001" to ·048".... „		350/-		68/-
Sheet 8'×2'. 20 gauge „		73/-		
Tube, representative average gauge ..... „		198/-		
Extrusions ..... „		90/-		
Zinc				
Sheet ..... ton	119	0	0	
Strip ..... „		nom.		

Domestic and Foreign

Merchants' average buying prices delivered, per ton, 23/5/61.

	£
Aluminium	
New Cuttings	138
Old Rolled	104
Segregated Turnings	78
Brass	
Cuttings	170
Rod Ends	152
Heavy Yellow	143
Light	138
Rolled	159
Collected Scrap	142
Turnings	145
Copper	
Wire	220
Firebox, cut up	218
Heavy	217
Light	213
Cuttings	225
Turnings	197
Braziery	187

	£
Gunmetal	
Gear Wheels	210
Admiralty	210
Commercial	194
Turnings	189
Lead	
Scrap	56
Nickel	
Cuttings	—
Anodes	550
Phosphor Bronze	
Scrap	194
Turnings	189
Zinc	
Remelted	75
Cuttings	66
Old Zinc	44

Financial News

Armstrong Whitworth (Metal Industries)

Final dividend 10 per cent, making 12½ per cent for 1960 (same). Profit £303,054 (£455,692), less tax £110,668 (£230,980). Net profit £192,386 (£224,712). To general reserve £50,000 (same). Forward £214,872 (£153,260).

Coley Metals

Dividend 15 per cent for the year ended January 31, 1961 (same). Group net profit £40,928 (£46,223), after tax £38,914 (£45,488). Dividends take £27,563 (£27,562). Goodwill of subsidiary companies acquired during year written off £2,812 (£2,984).

Union Miniere

It is reported from Brussels that Union Miniere du Haut Katanga's net earnings last year totalled 2,365,000,000 Belgian francs, compared with 3,611,000,000 the previous year. Proposed dividend is 1,500 Belgian francs per share, compared with 2,200 for 1959. Copper output costs of Union Miniere rose last year, offsetting the small rise in selling prices, according to the company's annual report.

Copper output last year amounted to 300,675 tons, compared with 280,403 tons during 1959. Cobalt output declined slightly to 8,222 tons from 8,431 tons in 1959. Deliveries of uranium oxide to the U.S. stopped during the course of last year. The Shinkolobwe mine was exhausted and the concentrator there ceased operations. Union Miniere delivered 27·6 grammes of uranium in 1960, compared with 101·619 grammes in 1959.

Associated Lead Manufacturers

Profit, 1960, £745,000 (£938,000), less tax £391,000 (£450,000). Net profit £354,000 (£488,000). Off goodwill and processes nil (£86,000), net dividend £350,000 (£486,000). Forward £271,000 (£267,000).

An Acquisition

It has been announced by Baxter, Fell and Company Ltd. that they have acquired the whole of the share capital of Aluminium Goods Limited, of Newcastle upon Tyne. Mr. D. F. Baxter, Mr. D. R. Peacock and Mr. W. G. J. Wade, of Baxter, Fell & Company, have joined the board, Mr. Baxter becoming chairman and Mr. Peacock deputy chairman. Mr. W. R. Earle and the present directors are remaining in office, and Mr. Geoffrey Hammonds, who has been a director of Aluminium Goods Ltd. for many years, has been appointed managing director. The general policy of the company will, it is understood, remain unchanged.

Harvey Aluminium

News from Washington is to the effect that Harvey Aluminium Incorporated plans a public offering of 1,000,000 shares of Class A common stock to help finance a construction programme aimed at making the company a fully integrated aluminium producer. The offering would be worth about $35,000,000, based on recent quotations in over-the-counter market. The company disclosed its plans for the offering in a registration statement filed with the Securities and Exchange Commission.

The company, which is one of the smaller U.S. aluminium producers and is based in Torrance, California, told the S.E.C. that it planned to develop into a producer capable of processing aluminium from the ore to finished metal stage including construction of an alumina plant sufficient to supply its reduction plant and construction of a 60,000 ton capacity aluminium rolling mill. The alumina plant is expected to cost $35,000,000 and the rolling mill $40,000,000. In addition, Harvey said it might acquire additional facilities or companies.

Glynwed Tubes Ltd.

The directors report that the issue of 1,000,000 shares of 5s. each at 20s. per share by way of rights was subscribed to the extent of 99·03 per cent. Applications for additional shares amounted to 522,493 shares. Applications for up to ten additional shares will be allotted in full. Larger applications have been selected by ballot to receive a graded nominal allotment.

Kaiser-Kawneer Merger

It is reported from San Francisco that Kaiser Aluminum and Chemical Corporation and Kawneer Company have terminated their agreement to merge. In April, the U.S. Justice Department filed an anti-trust suit against the proposed merger in a St. Louis court. A restraining order against the proposed merger is still in effect. The companies said a decision could not be expected for some time. Both companies postponed special shareholder meetings earlier this month which were to vote on the merger.

Kaiser Aluminum and Kawneer said: "The decision to terminate the agreement was reached because the two companies have found it impossible to agree upon a number of basic matters pertaining to procedures and operations during the pendency of the suit".

Scrap Metal Prices

The figures in brackets give the English equivalents in £1 per ton:—

France (new francs per kilo):

Electrolytic copper scrap	(£221.14.0)	3.00
Heavy copper	(£221.14.0)	3.00
No. 1 copper wire	(£206.18.0)	2.80
Brass rod ends	(£169.19.0)	2.30
Zinc castings	(£71.13.0)	0.97
Lead	(£66.10.0)	0.90
Aluminium	(£125.12.0)	1.70

Italy (lire per kilo):

Aluminium soft sheet clippings (new)	(£178.2.0)	305
Lead, soft, first quality	(£81.15.0)	140
Lead, battery plates	(£46.14.0)	80
Copper, first grade	(£227.15.0)	390
Bronze, commercial gunmetal	(£201.9.0)	345
Brass, heavy	(£163.10 0)	280
Brass, light	(£152.16.0)	260
Brass, bar turnings	(£163.10.0)	280
Old zinc	(£64.4.0)	110

Japan (Yen per metric ton):

Electrolytic copper	(£—)	295,000
Copper wire No. 1	(£—)	272,000
Copper wire No. 2	(£—)	257,000
Heavy copper	(£—)	257,000
Light copper	(£—)	225,000
Brass, new cuttings	(£—)	209,000
Red brass scrap	(£—)	215,000

West Germany (D-marks per 100 kilos):

Used copper wire	(£209.10.0)	230
Heavy copper	(£209.10.0)	230
Light copper	(£182.4.0)	200
Heavy brass	(£136.13.0)	150
Light brass	(£100.4.0)	110
Soft lead scrap	(£52.16.0)	58
Zinc scrap	(£52.16.0)	58
Used aluminium unsorted	(£81.19.0)	90

Trade Publications

Electrical Air Filters.—W. C. Holmes and Co. Ltd., P.O. Box No. B.7, Turnbridge, Huddersfield.

The "Industrion" air furnaces are described in an 8-page brochure with technical details, diagrams and photographs.

Chemical Engineering Products.—W. C. Holmes and Co. Ltd., P.O. Box No. B.7, Turnbridge, Huddersfield.

This brochure gives details of the products of the Holmes company, and covers the chemical engineering division, gas handling division, and gas cleaning division. Many illustrations are given of plants installed at the works of many firms.

Process Plant Efficiency.—Head, Wrightson and Company Ltd., Ship House, 20 Buckingham Gate, London, S.W.1.

This company has been actively concerned with the problems of cooling and heating process fluids for many years, and their recent expansion in the water and effluent treatment field, now enables them to offer a comprehensive service to all process plant users for improved efficiency. A leaflet has been prepared to demonstrate briefly the extent of this service, and the company's recent association with I.C.I. gives a further impetus to the great problem of the treatment of trade wastes. A second leaflet, concerning the Series One cooling tower, gives details of this equipment, which is specifically designed for small industrial and air conditioning applications.

Dust Arresters.—The Incandescent Heat Company Limited, Cornwall Road, Smethwick, Birmingham.

A new leaflet deals with the wide use of Whiting dust arresters on cupolas. A number of illustrations show these arresters in use on cupolas ranging in size from 2 to 35 tons/hr.

Variable Speed Gears. — Carter Gears Ltd,. Thornbury Road, Bradford, 3, Yorks.

A twelve-page brochure is devoted to details of the new 10 h.p. size AM26 Carter hydraulic variable speed gear, which is the latest addition to this company's existing range of such gears.

Stud Welding. — Crompton Parkinson Ltd., Crompton House, Aldwych, London, W.C.2.

This leaflet concerns stud welding attachments and illustrates a wide selection of both standard studs and studs of special shapes. The company makes welding attachments of almost any shape and size to customers' own specifications.

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ISSUED CAPITAL •	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 19 MAY	+RISE—FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1961 HIGH	1961 LOW	1960 HIGH	1960 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation	33/-	—6d.	11	9	6 13 3	33/9	26/3	35/-	26/6
400,000	2/-	Anti-Attrition Metal	1/3		NIL	4	NIL	1/3	0/9	1/6	0/9
43,133,593	Stk. (£1)	Associated Electrical Industries	43/3	+9d.	15	15	6 18 9	54/10½	40/3	67/3	38/3
3,895,963	1	Birfield	73/9	—5/-	10	15‡	2 14 3	78/9	45/-	51/3	29/-
4,795,000	1	Birmid Industries	95/-	+2/-	20	20D	4 4 3	103/-	71/3	74/9	56/-
8,445,516	Stk. (10/-)	Birmingham Small Arms	34/-	—9d.	17½QT	12½	3 6 6	36/10½	24/9	30/6	18/3
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	14/6		5	5	6 18 0	14/6	13/9	17/4½	14/9
476,420	Stk. (£1)	Ditto Cum. B. Pref. 6%	17/-		6	6	7 1 3	17/6	16/9	20/-	17/1½
500,000	1	Bolton (Thos.) & Sons	58/9	+1/3	12½	10	4 5 3	57/6	37/6	43/-	36/-
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18,846,647	Stk. (£1)	British Insulated Callender's Cables	58/3	—9d.	13½	13½	4 12 9	62/-	50/4½	61/4½	47/-
20,456,599	5/-	British Oxygen Co. Ltd., Ord.	25/9xcap	—1/9	16D	16	2 1 6	28/4½	17/6	35/-	19/10½
1,200,000	Stk. (5/-)	Canning (W.) & Co.	16/4½	—3d.	15⅞	25+*2½C‡	4 14 0	20/9	13/7½	19/9	13/7½
60,484	1/-	Carr (Chas.)	1/1½		NIL	12½	—	1/7½	1/-	2/3	1/-
555,000	1	Clifford (Chas.) Ltd.	29/6	+6d.	12	10	8 2 6	29/6	26/-	35/-	28/9
45,000	1	Ditto Cum. Pref. 6%	15/3		6	6	7 17 6	15/3	15/1½	16/-	15/10½
300,000	2/-	Coley Metals	4/-	—3d.	15	15	7 10 0	4/3½	3/6	5/-	3/4½
10,185,696	1	Cons. Zinc Corp.†	73/-		20	15	5 9 6	81/6	64/-	80/9	59/6
5,399,056	1	Davy-Ashmore	176/-	—1/-	30‡	20	1 14 0	177/-	129/6	147/3	99/6
8,000,000	5/-	Delta Metal	27/-	—3d.	20	17½	3 14 0	27/7½	19/9	28/3	18/6
5,296,550	Stk. (£1)	Enfield Rolling Mills Ltd.	45/9	—2/6	15	15	6 11 0	52/3	45/-	56/9	45/-
1,155,000	1	Evered & Co.	44/6xd		10B	10ϕ	3 0 0	45/-	42/6	42/9	29/3
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2,500,000	5/-	Glynwed Tubes	29/3		22½	25¶	3 17 0	30/-	23/7½	27/6	17/-
7,228,065	10/-	Goodlass Wall & Lead Industries	38/9	—2/3	15	19L	3 13 3	44/9	34/9	41/9	33/-
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1,612,750	5/-	Heenan Group	16/9	+3d.	13	15	3 17 9	17/1½	10/6	13/-	9/10½
251,689,407	Stk. (£1)	Imperial Chemical Industries	78/-	—1/6	13½	11½	3 10 6	81/6	63/1½	76/6	54/-
34,736,773	Stk. (£1)	Ditto Cum. Pref. 5%	16/-		5	5	6 5 0	16/-	14/10½	18/-	15/4½
29,196,118	**	International Nickel	146½		$1.60	$1.50	2 0 0	152½	104	105	84½
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	14/6		5	5	6 18 0	14/10½	14/-	16/6	14/6
6,000,000	1	Ditto Ord.	62/3	—1/9	12	12D	3 17 0	64/3	59/6	67/6	44/9
600,000	10/-	Keith, Blackman	21/3		17½	17½E	8 4 9	21/6	18/3	32/6	17/6
320,000	4/-	London Aluminium	14/4½	+3d.	12	10	3 6 9	15/-	8/6	12/6	7/10½
765,012	1	McKechnie Bros. Ord.	65/-		17½F	15F	5 7 9	65/-	53/6	71/6	57/3
1,530,024	1	Ditto A. Ord.	64/3		17½F	15F	5 9 0	64/3	53/3	69/3	55/-
1,108,268	5/-	Manganese Bronze & Brass	16/-		20⅞	20⅞	6 10 0	18/6	14/-	18/6	13/4½
50,628	6/-	Ditto (7½% N.C. Pref.)	5/9	+3d.	7½	7½	7 16 0	6/-	5/4½	6/6	5/9
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585,000	5/-	Ratcliffs (Great Bridge) Ord.	15/9		10	10R	3 3 6	16/6	15/9	17/-	14/9
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6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	20/6		*5	*5	7 5 0A	21/1½	19/9	24/6	20/1½
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591,000	5/-	Wolverhampton Metal	28/8		32½	27½	5 13 0	30/-	24/6	39/9	23/9
156,930	2/6	Wright, Bindley & Gell	4/7½		15	20‡	8 2 3	4/7½	3/7½	4/6	2/10½
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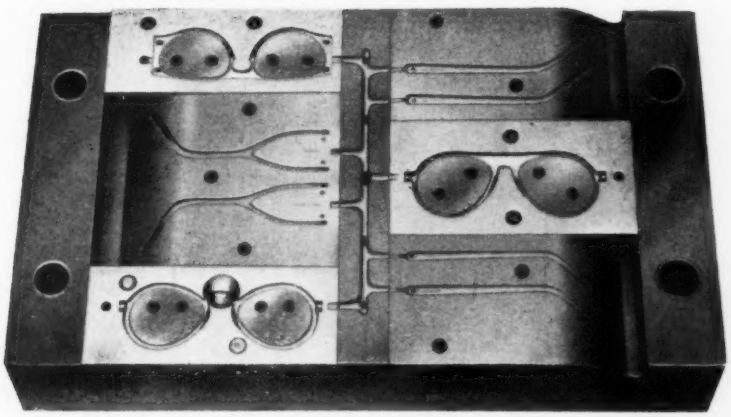

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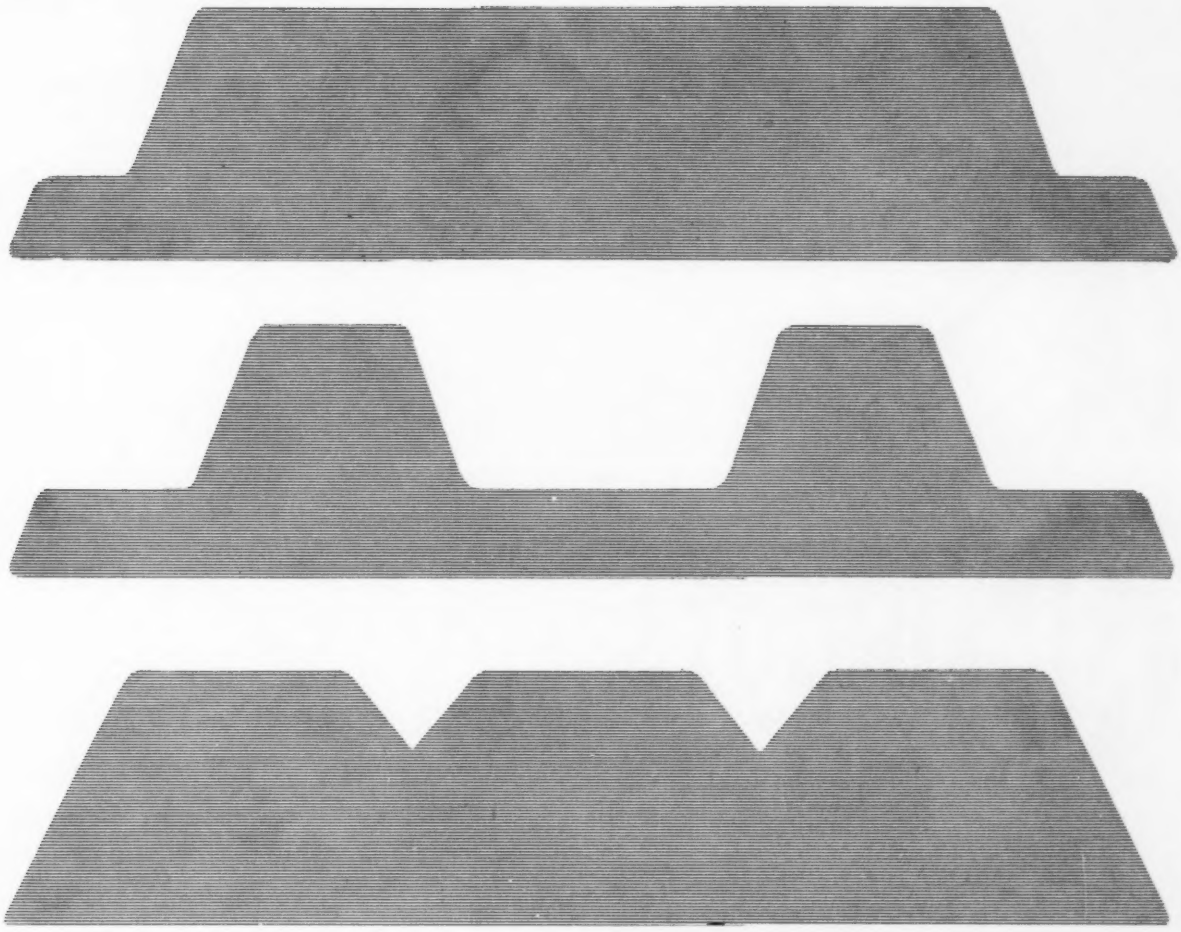

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Item 2. Two—24" × 54" TWO-HIGH SHEET ROLLING MILLS by Davy & United, with cast iron rolls running in grease lubricated bearings. Drive for the two mills is by 200 h.p., 585 r.p.m., 400 volt AC motor through centrally located totally enclosed combined double reduction and double mill pinion gearbox, with flywheels on the high speed shaft, giving an operating speed of 200 feet per minute. Screwdown is by handwheel through cross shaft and gearing, with disengaging clutch.

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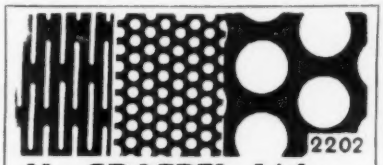

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